NOAA Pipeline/BUFR/CBUFR, schedule, clear flag and cloud-cleared filter

November 2001 AIRS science team meeting

NOAA/NESDIS

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Topics

- Deliverable AIRS Products
- NOAA Pipeline
- Hardware Upgrade
- Post-launch schedule
- Clear Detection
- Cloud cleared radiances - CBUFR
- Validation of NRT products via gridded datasets
- Apply clear detection algorithm on cloud cleared radiances.

NWP AIRS Products

- Thinned Radiance files

  a) center of 3 x 3 from every other golf ball,
  ~300 channels. + AMSU and HSB (8 mbytes per orbit)

  b) 200 principal component scores using same thinning as a)

  c) Every 2nd golfball with ~300 channels
  plus all AMSU and HSB (all 3 x 3)

  d) cloud cleared a) and b)

  e) Full resolution AMSU and HSB

  * all include cloud indicator

- Full resolution level 2 products – temperature, moisture and ozone.
  (Level 2 PGE running in NRT since July 2001)

Current List of Users

- NCEP
- ECMWF
- Met. Office
- Meteo-France
- Goddard DAO
- Meteor. Service of Canada

NOAA Pipeline

- The center FOV of every other golf ball in BUFR format is being delivered to the NWP centers in near-real time.
- One week of simulated level 1B and level 2 data have been delivered to the DAO.
- Nine FOVs of every other golf ball in BUFR format for three granules has been delivered to the DAO.

NOAA Pipeline

- ECMWF model forecast data in GRIB format is delivered to UMBC on a weekly basis.
- ECMWF model forecast data in GRIB format for December 2000 has been delivered to JPL.
- AIRS/AMSU/HSB data matched to the ARM CART site is delivered on a daily basis to UW-Madison.
- AIRS/AMSU/HSB level 1b radiances and retrievals matched to radiosonde locations for validation.

NOAA Pipeline

- Daily Global Grids (0.5 x 2.0 resolution) of
- observed radiances (center fov)
  initial and final cloud cleared radiances
  principal component scores of above
  retrievals from level 2 support file
  NCEP and ECWMF forecasts
  clear simulated radiances from NCEP and ECMWF

Key to validation of NRT products as well as generation of coefficients.

Binary Grid files created each day ~ 2 GB

Name	Size	Type	Modified
EC20011011.asc	64,753KB	ASC File	10/12/01 6:03 PM
EC20011011.desc	64,753KB	DESC File	10/12/01 6:04 PM
FF20011011.asc	97,001KB	ASC File	10/12/01 5:22 AM
FF20011011.desc	97,001KB	DESC File	10/12/01 5:24 AM
→ FI20011011.asc	89,579KB	ASC File	10/12/01 8:03 AM
FI20011011.desc	89,579KB	DESC File	10/12/01 8:05 AM
GG20011011.asc	80,621KB	ASC File	10/12/01 5:26 AM
GG20011011.desc	80,621KB	DESC File	10/12/01 5:28 AM
gs_ec20011011.asc	72,431KB	ASC File	10/12/01 11:13 AM
gs_ec20011011.desc	72,431KB	DESC File	10/12/01 11:15 AM
gs20011011.asc	72,431KB	ASC File	10/12/01 11:13 AM
gs20011011.desc	72,431KB	DESC File	10/12/01 11:15 AM
IN20011011.asc	89,579KB	ASC File	10/12/01 8:10 AM
→ IN20011011.desc	89,579KB	DESC File	10/12/01 8:12 AM
L2RET20011011.asc	316,339KB	ASC File	10/12/01 1:21 PM
L2RET20011011.desc	316,339KB	DESC File	10/12/01 1:31 PM
PCD20011011.asc	60,146KB	ASC File	10/12/01 5:31 AM
PCD20011011.desc	60,146KB	DESC File	10/12/01 5:33 AM
PCFI20011011.asc	54,003KB	ASC File	10/12/01 8:06 AM
PCFI20011011.desc	54,003KB	DESC File	10/12/01 8:08 AM
PCIN20011011.asc	54,003KB	ASC File	10/12/01 8:13 AM
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PCS20011011.asc	60,146KB	ASC File	10/12/01 5:29 AM
PCS20011011.desc	60,146KB	DESC File	10/12/01 5:30 AM

All channels ~ 10 GB

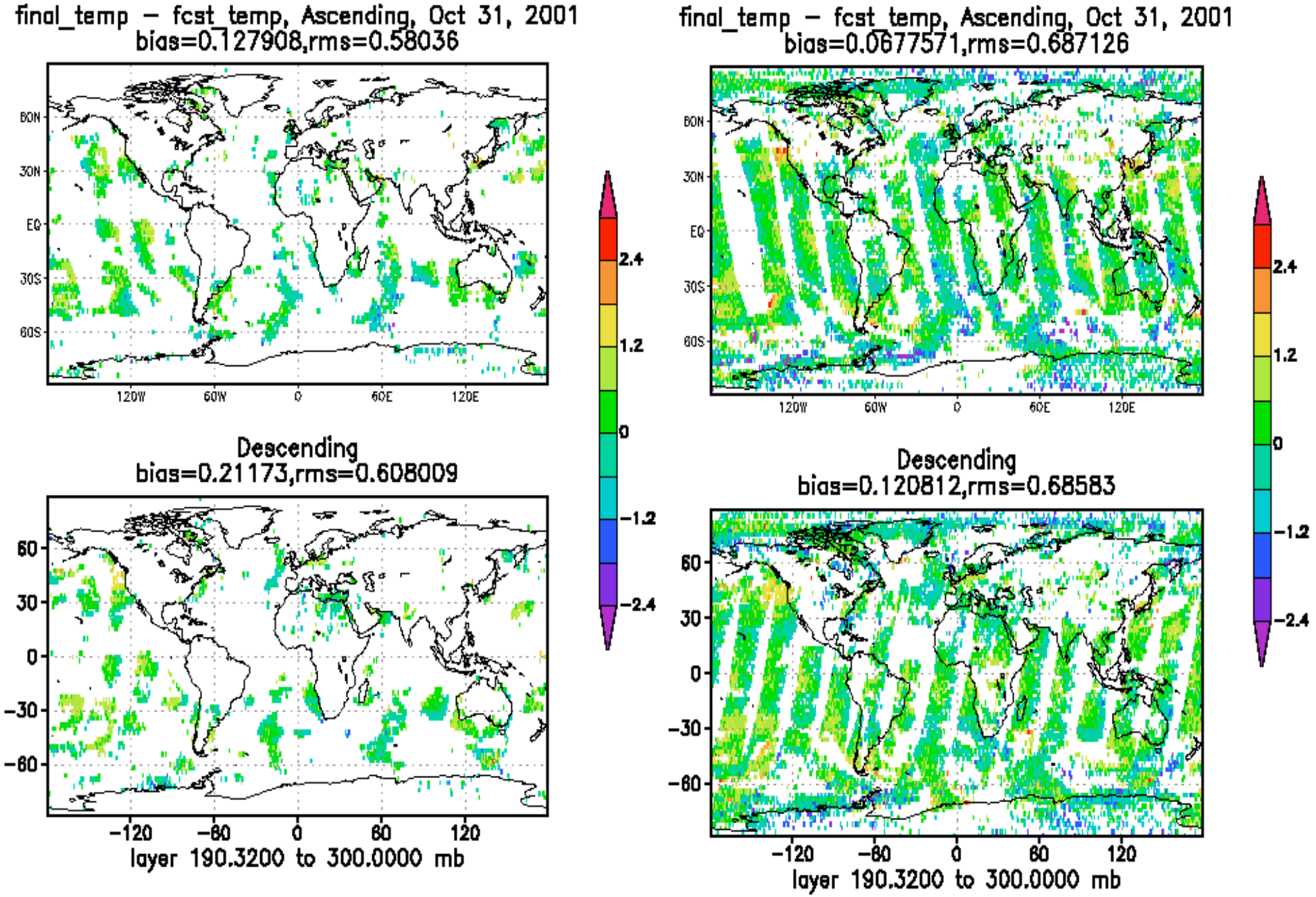
Deliverable AIRS BUFR Files

- Originally based off TOVS BUFR Format
- One BUFR file per granule
- Center Field of View for every other golf ball
- 281 AIRS Channels, 15 AMSU Channels, and 4 HSB Channels
- Each file is approximately 650 KB

Updates to AIRS BUFR Files

- Center Field of View for every golf ball might become clearest Field of View.
- Principal Component BUFR File.
- Cloud/Clear Flag determinations.
- Separate Cloud Cleared BUFR file
- Visible channels

Cloud clearing significantly increases yield



Hardware Upgrade

- NASA NPP project has provided to NOAA 96 CPUs (SGI ORIGIN 3800 R12K) for MODIS and AIRS processing. (64 MODIS ,32 for AIRS) 8 TB storage
- Server - SGI Origin 3200 dual processor - 6 TB
- 20 RS10000 + 32 RS12000 CPUs dedicated to AIRS
- At least 6 TB for AIRS

Post Launch Schedule

• 2 months-- Establish routine transfer of rate-buffered data from EDOS to NOAA computer.

• 3 months -- updated level 1b software from JPL (as early as possible)

• 4 months – delivery of "first look" thinned radiance products to NWP centers

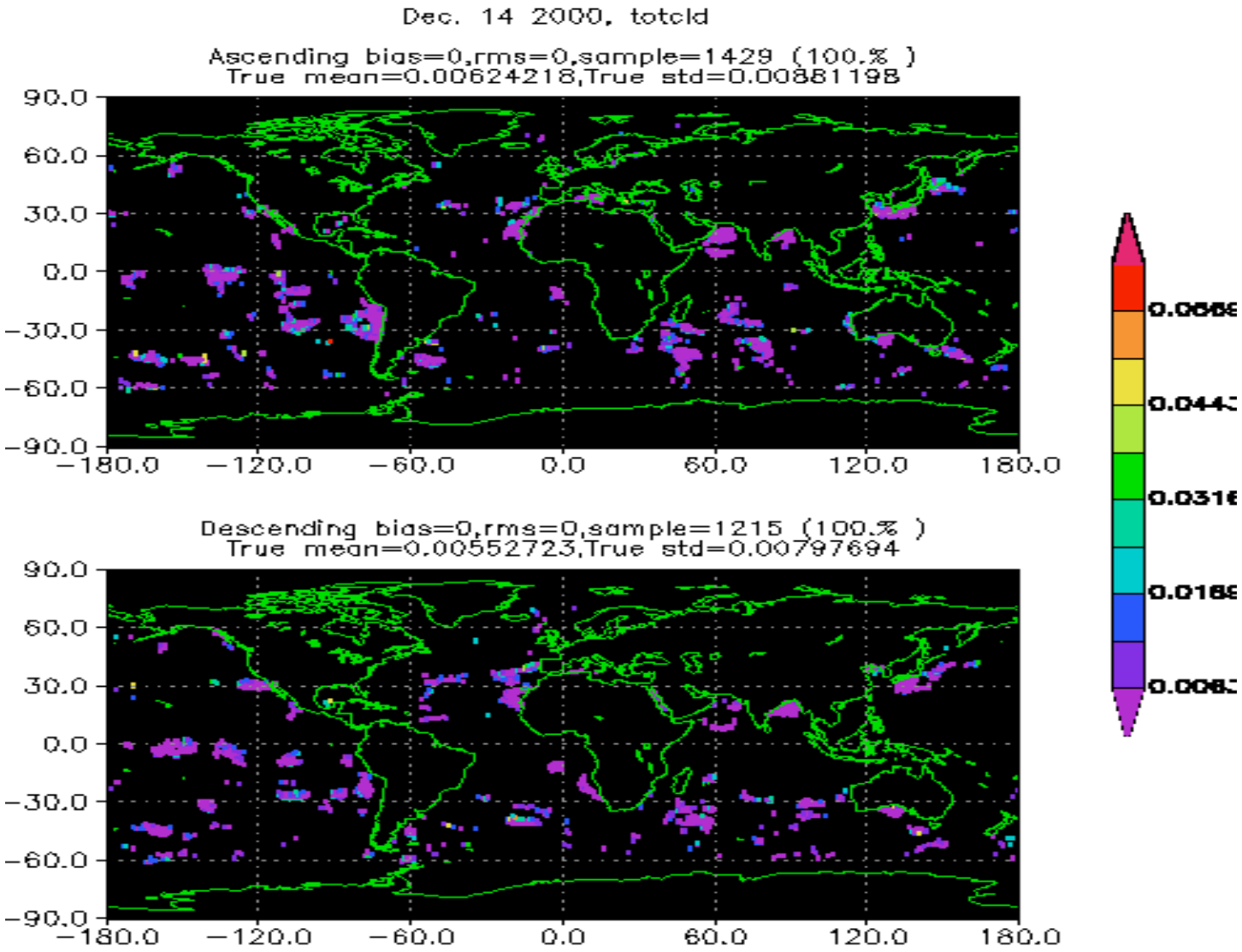
• 7 months -- routine distribution of validated thinned level 1b radiance products to NWP sites

•12 months – preliminary report on impact of AIRS in NWP.

•12 months -- routine distribution of level 2 products.

Clear Detection

Detected Clear FOVS using AIRS --- ONLY 0.5% residual clouds !!



Clear Detection tests

Ocean test 1: Brightness temperature (BT) of 965.323cm-1 (AIRS ch914) is greater than 268k (day/night)
Ocean test 2: The difference between the SST minus BT of 2616.095cm-1(AIRS ch2333) is less than 0.9 (night)
Ocean test 3: The difference between BT of ch2333 (2616.095) and the predicted 2616 from 8 microns is less than 0.5. (night)
Ocean test 4: The difference between BT of ch2333 (2616.095) and the predicted 2616 from 11 microns is less than 0.5. (night)
Ocean test 5: The difference between the forecast SST and the SST predicted from airs window channels is less than 0.2 (day/night)

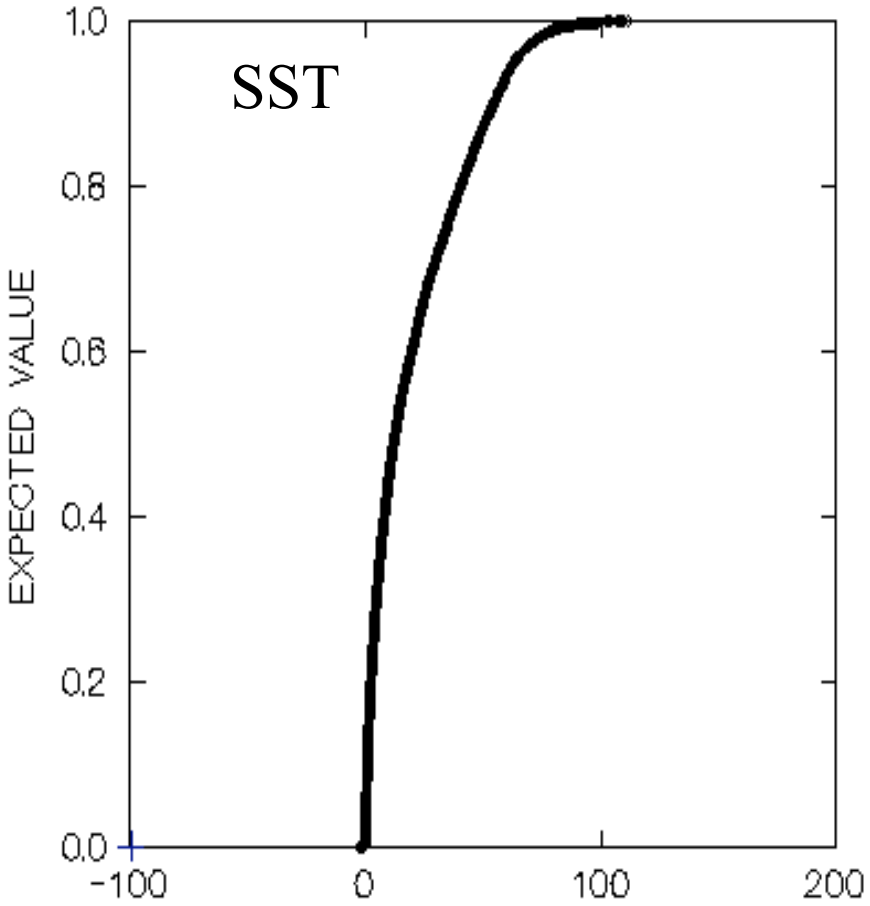
Land test 1: The difference between the BT of 2390.824cm-1(AIRS ch2112) and the one predicted from AMSU channel 1 to 7, is less than 3.0

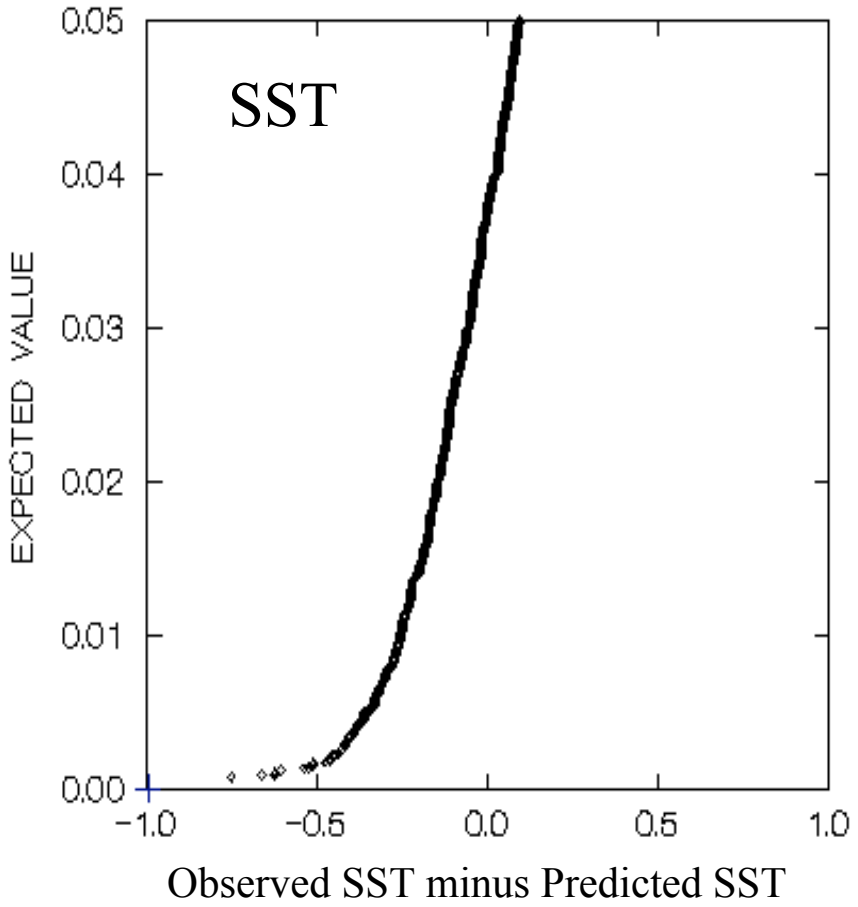
Land test 2: Spatial variability of 2390.824cm-1(AIRS ch2112) is less than 0.0030 mW

Land test 3: The difference between the BT of 2445.918cm-1 (AIRS ch2145) and which predicted from long-wave channels (1218.359cm-1, 1228.086cm-1, 1236.297cm-1, 1251.213cm-1), is less than zero
Land test 4: The difference between the forecast surface temperature and the one predicted from AIRS window channels is less than 10
Land test 5: The difference between the short-wave channel (2558.224cm-1 ch2250) and long-wave channel (900.562cm-1, ch760), is less than 10

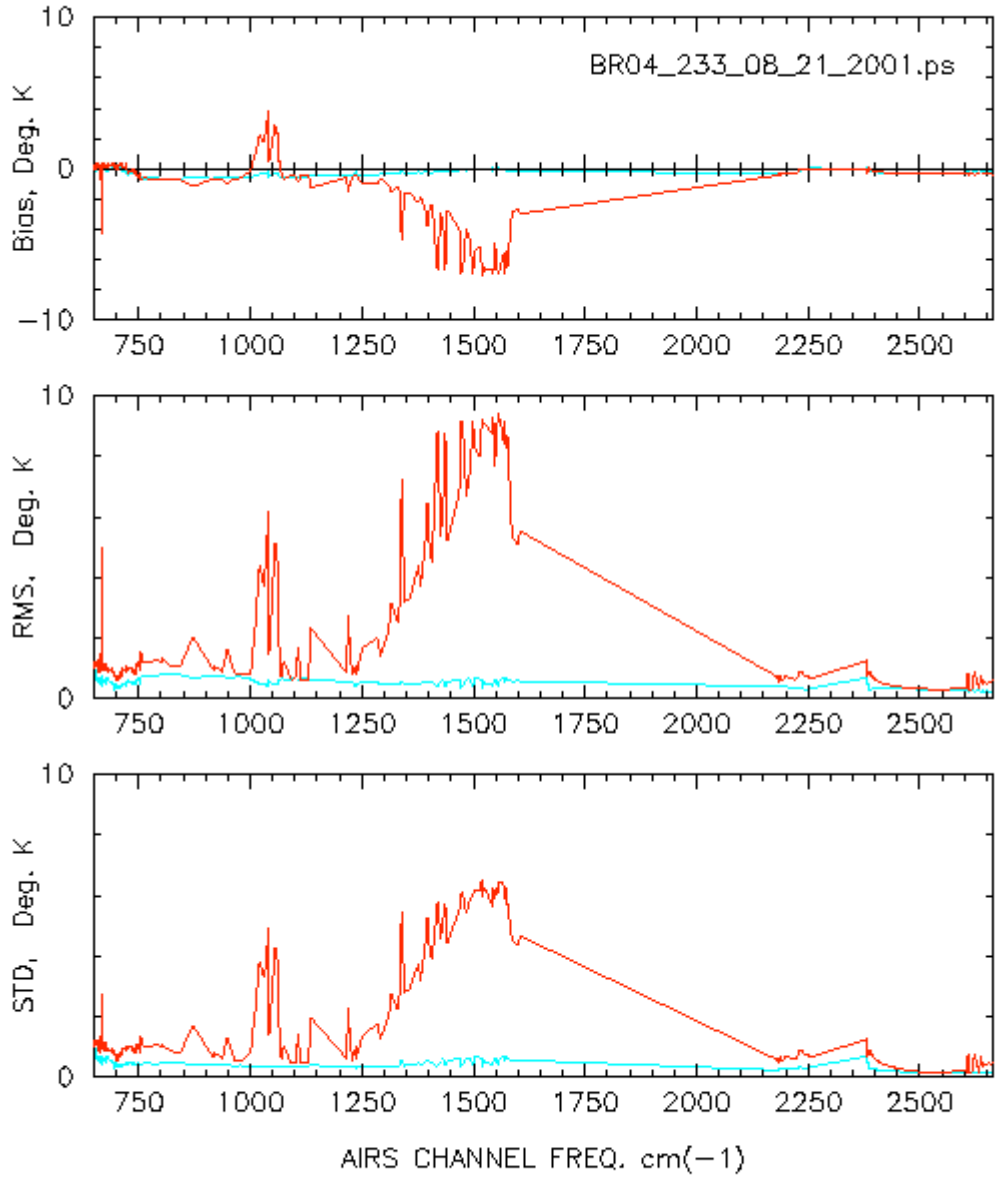
Approach to selecting “good” threshold :

use cumulative probability distribution and estimate of percent clear at the AIRS fov resolution





N_16_233_08_21_2001__16_293_10_20_2001 NCH: 281 N: 217 CASE: 4

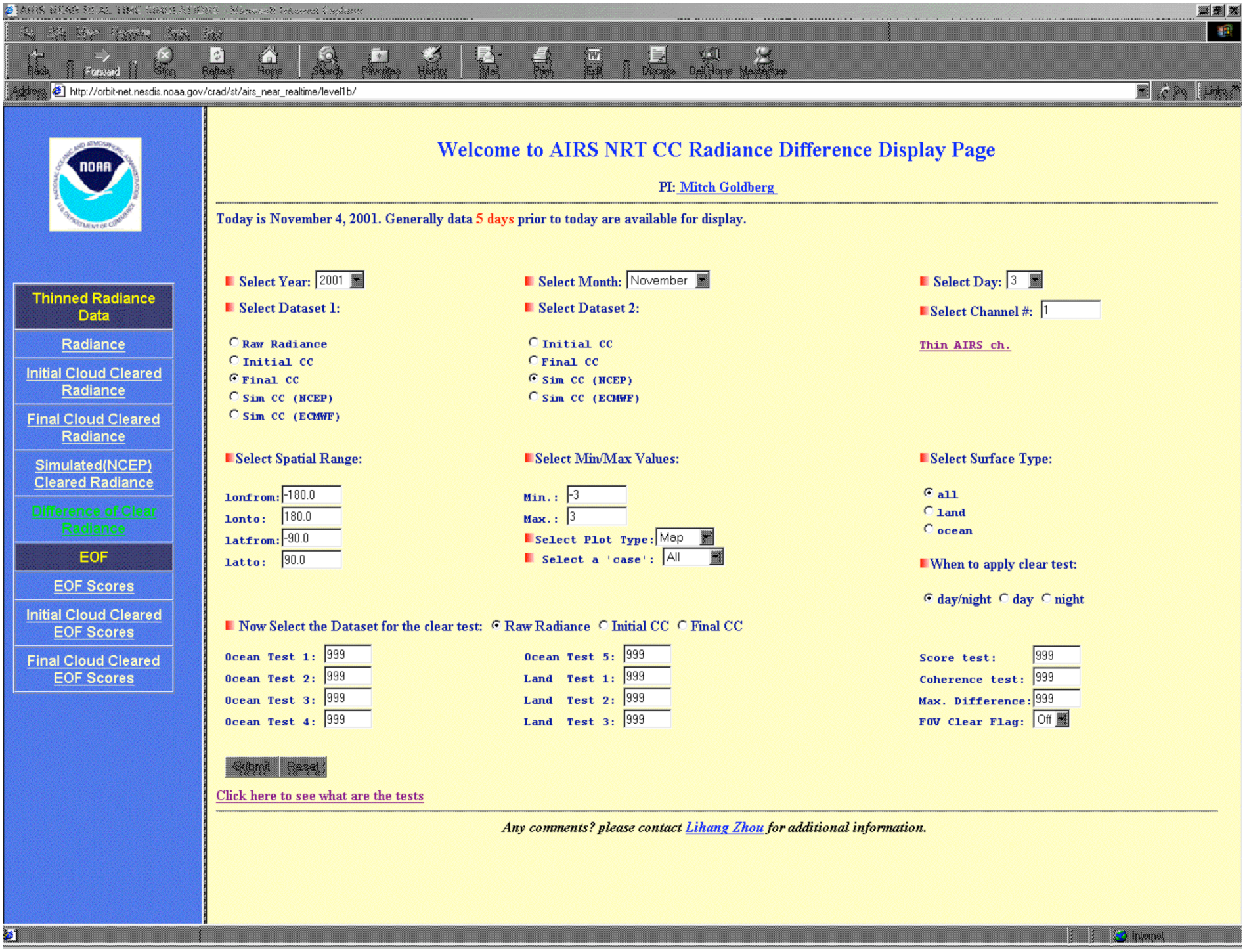


281 CH, OBS(Grid) − Sim(MF) CLR NSAMPLES : 217

281 CH, OBS(Grid) − Sim(RAOB) CLR NSAMPLES : 217

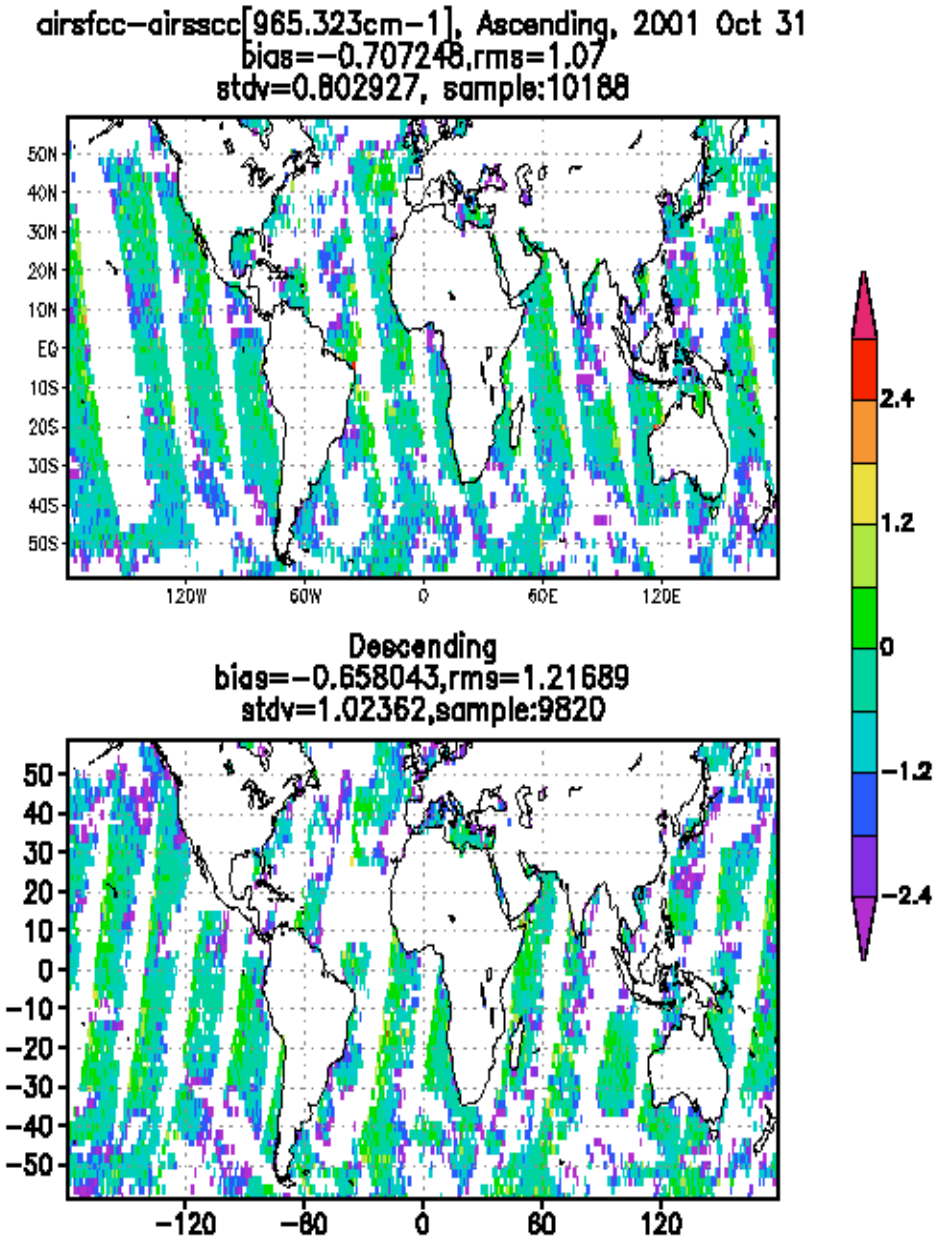
Routine Validation

- Web-based validation of radiance and retrieval products accessible by science team and NWP users.
- Compare retrievals with NCEP and ECMWF forecasts/analyses and radiosondes.
- Compare radiances with clear simulated radiances using NCEP and ECMWF geophysical parameters.
- Based on gridded datasets and radiosonde collocations.

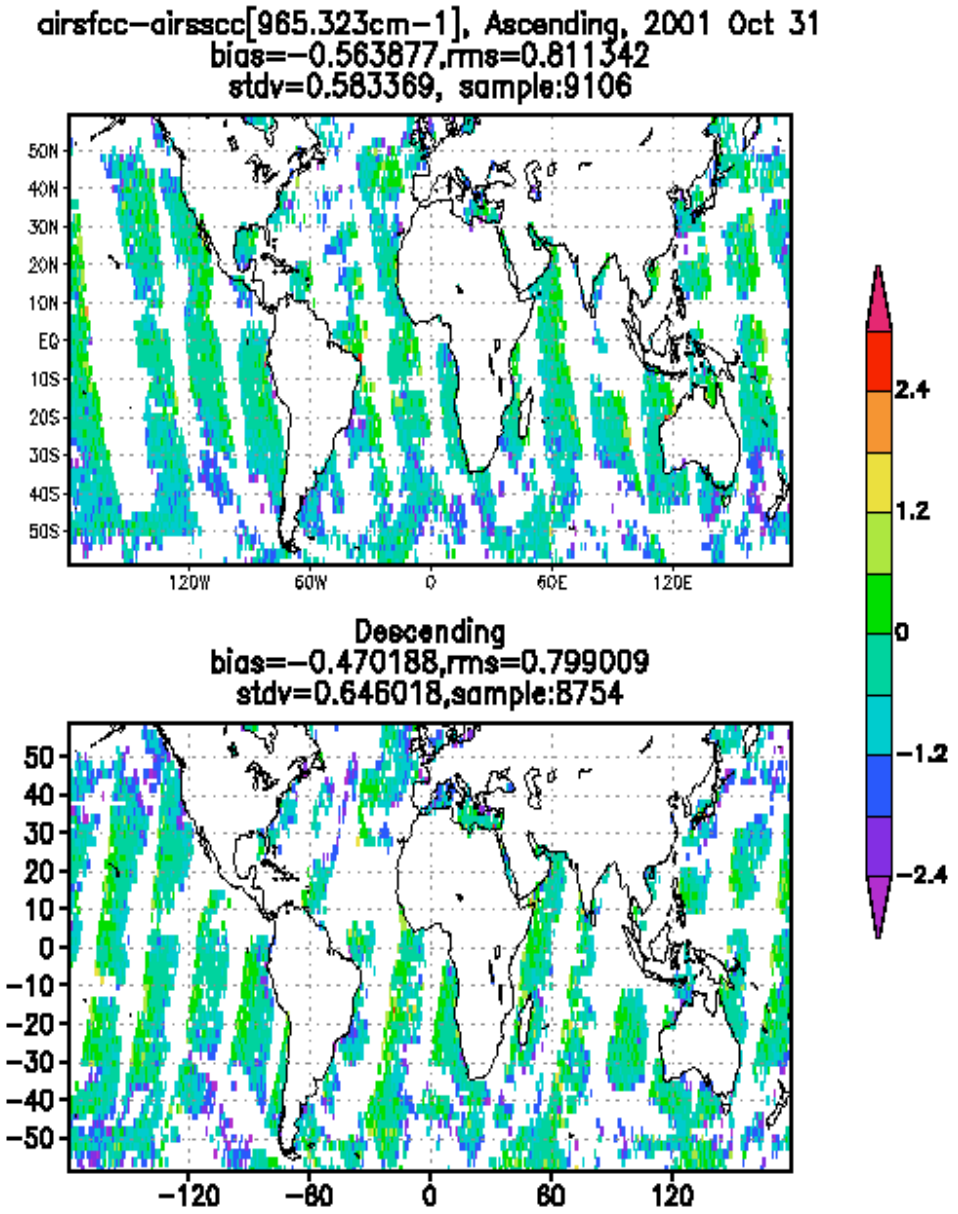

http://orbit-net.nesdis.noaa.gov/crad/st/airs_near_realtime/level1b/
Thinned Radiance Data
Radiance
Initial Cloud Cleared Radiance
Final Cloud Cleared Radiance
Simulated(NCEP) Cleared Radiance
Difference of Clear Radiance
EOF
EOF Scores
Initial Cloud Cleared EOF Scores
Final Cloud Cleared EOF Scores
Welcome to AIRS NRT CC Radiance Difference Display Page
PI: Mitch Goldberg
Today is November 4, 2001. Generally data 5 days prior to today are available for display.
Select Year: 2001
Select Month: November
Select Day: 3
Select Dataset 1:
Raw Radiance
Initial CC
Final CC
Sim CC (NCEP)
Sim CC (ECMWF)
Select Dataset 2:
Initial CC
Final CC
Sim CC (NCEP)
Sim CC (ECMWF)
Select Channel #: 1
Thin AIRS ch.
Select Spatial Range:
lonfrom: -180.0
lonto: 180.0
latfrom: -90.0
latto: 90.0
Select Min/Max Values:
Min.: -3
Max.: 3
Select Plot Type: Map
Select a 'case': All
Select Surface Type:
all
land
ocean
When to apply clear test:
day/night day night
Now Select the Dataset for the clear test: Raw Radiance Initial CC Final CC
Ocean Test 1: 999
Ocean Test 2: 999
Ocean Test 3: 999
Ocean Test 4: 999
Ocean Test 5: 999
Land Test 1: 999
Land Test 2: 999
Land Test 3: 999
Score test: 999
Coherence test: 999
Max. Difference: 999
FOV Clear Flag: Off
Submit
Reset
Click here to see what are the tests
Any comments? please contact Lihang Zhou for additional information.

Cloud Cleared Filter

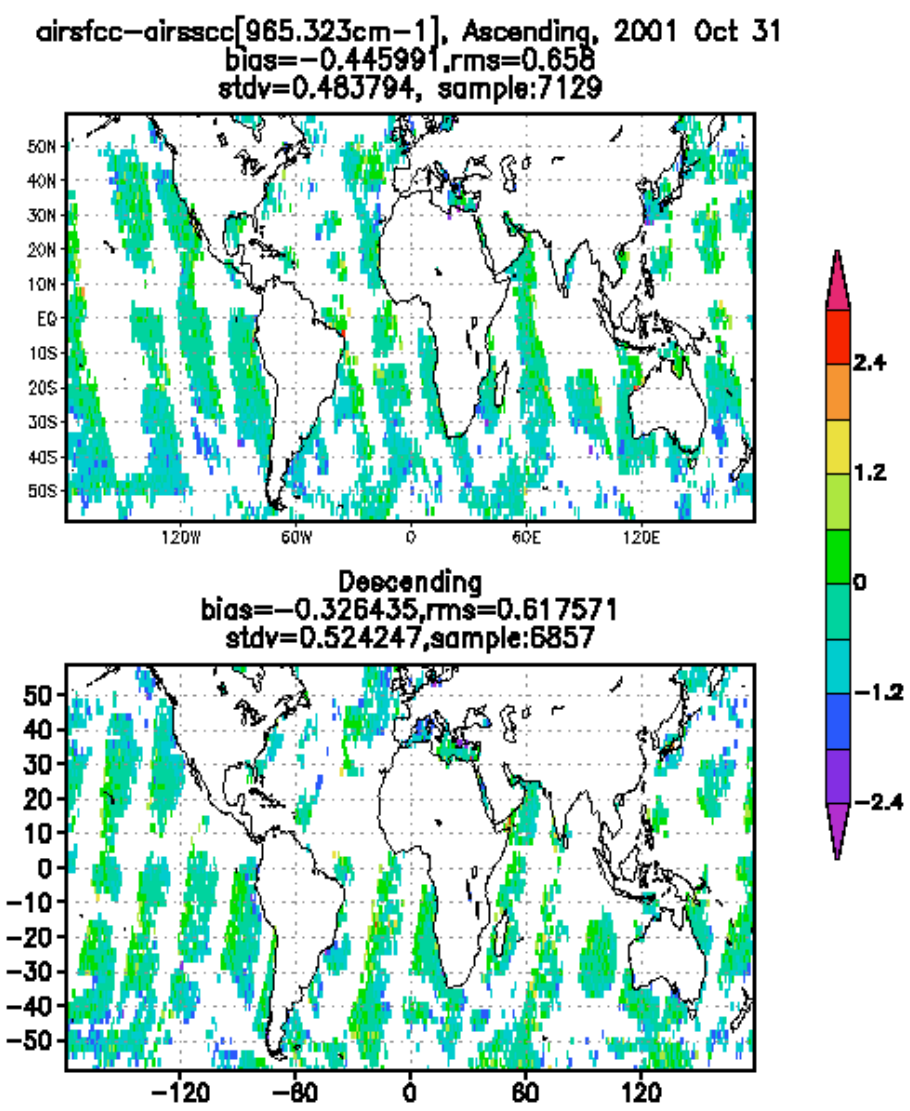
CASE 3



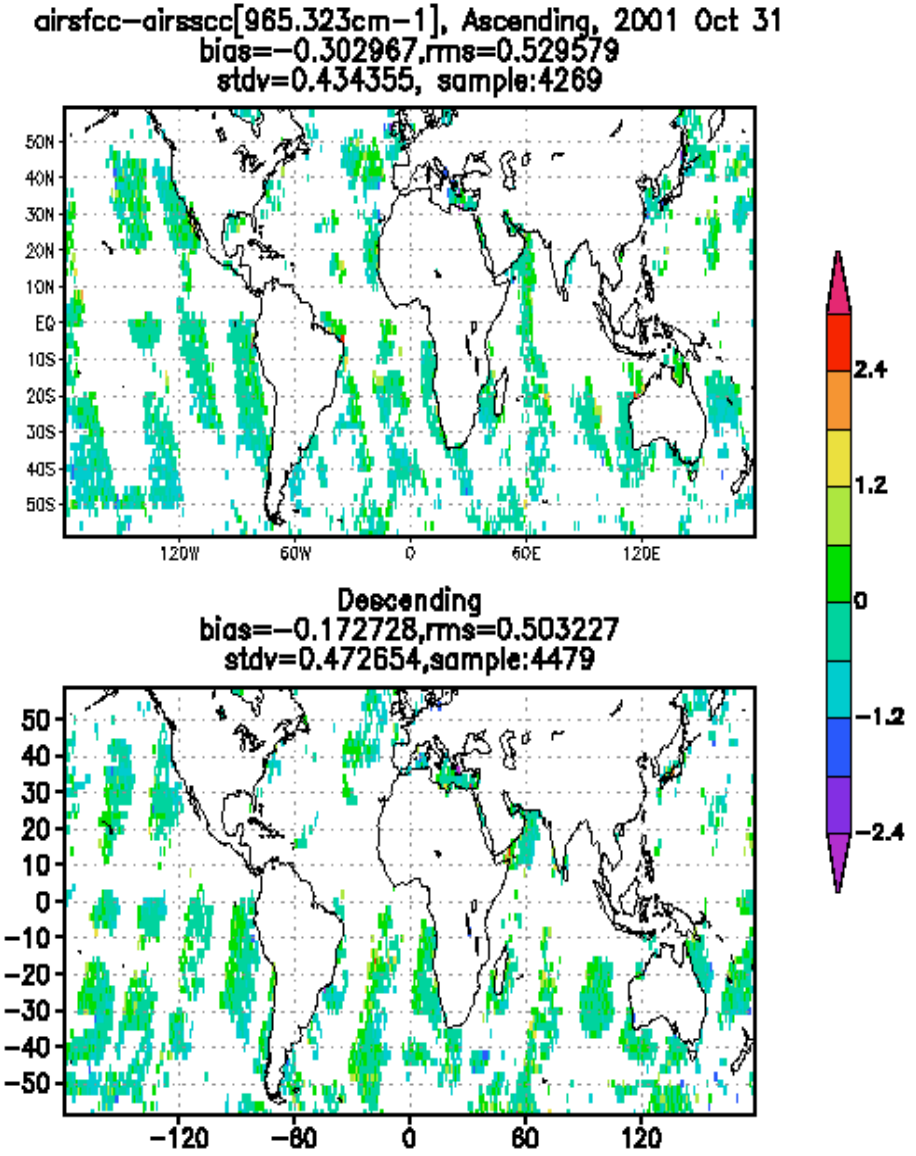
CASE 3 + 2 K SST check



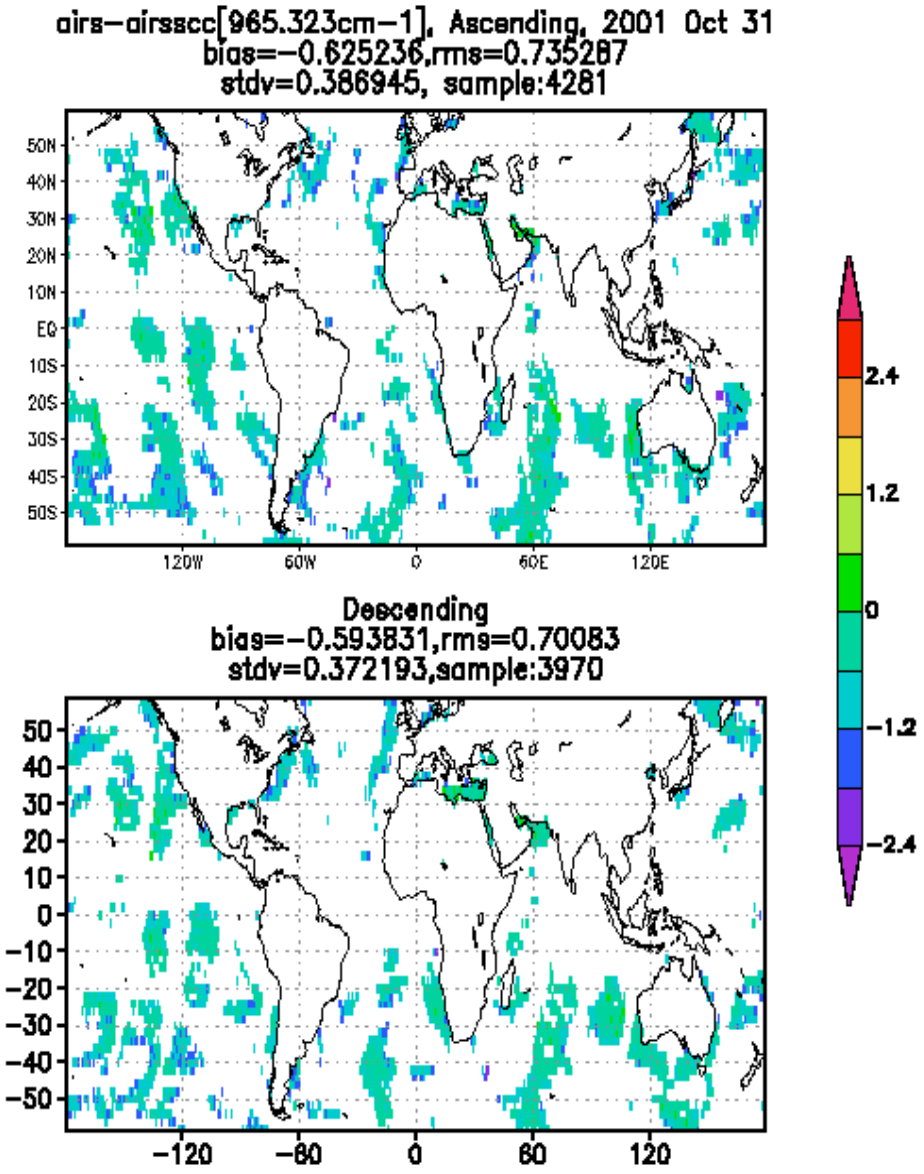
1 K SST Check



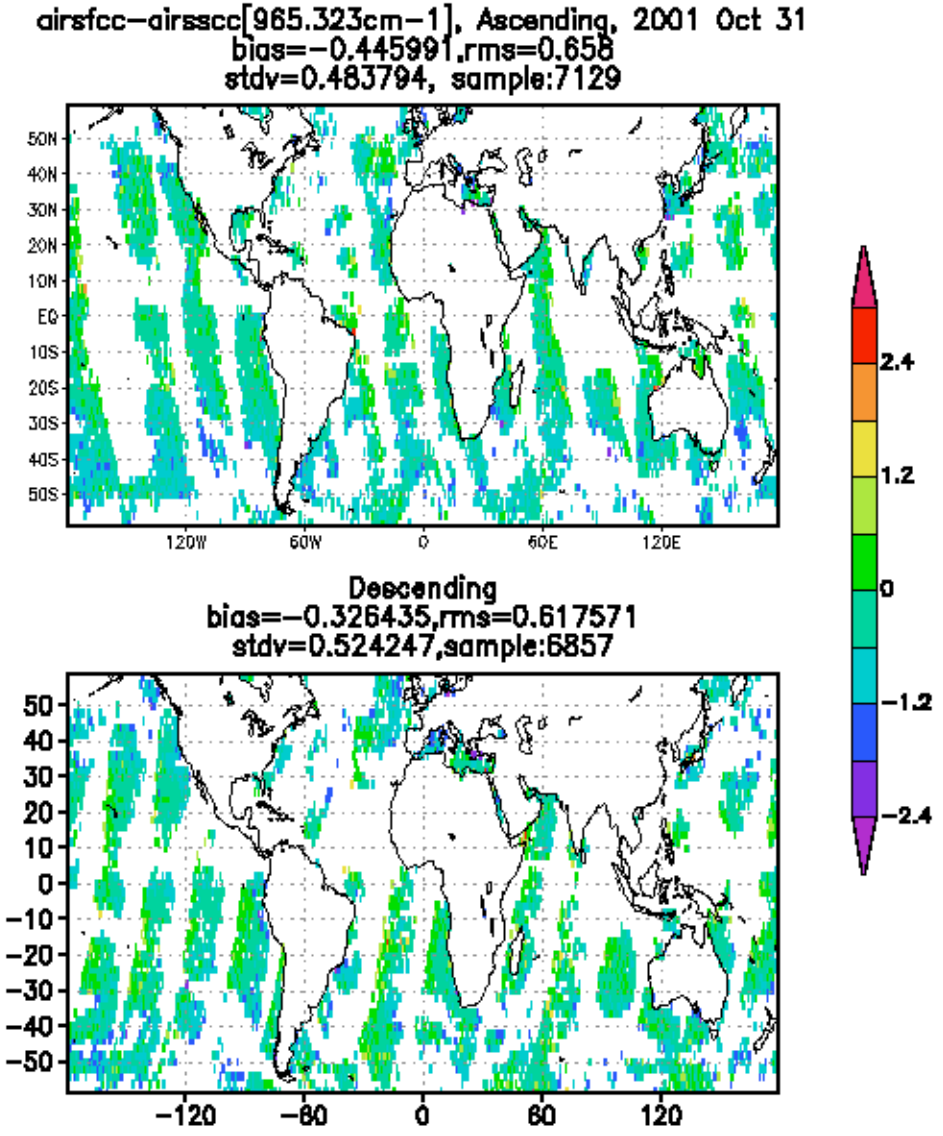
0.5 K SST Check



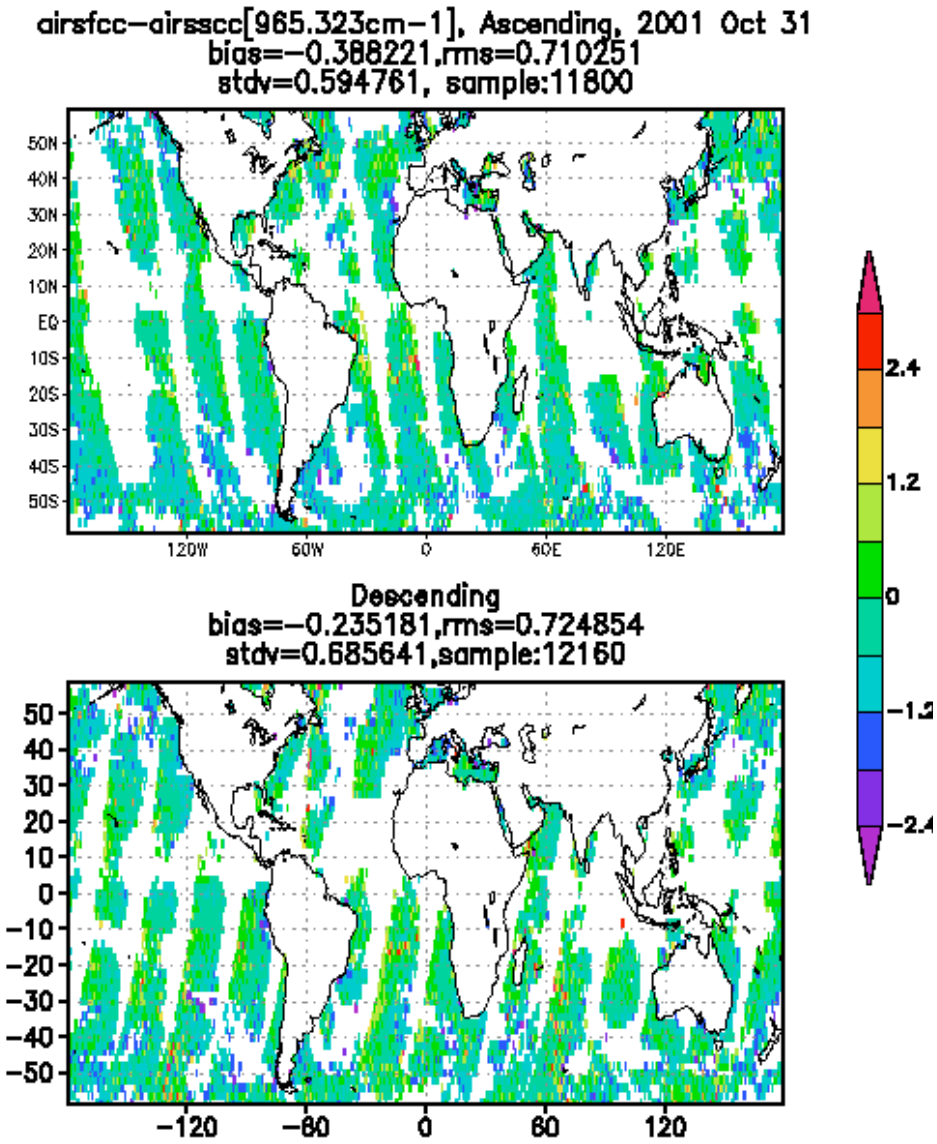
Observed 1 K SST check



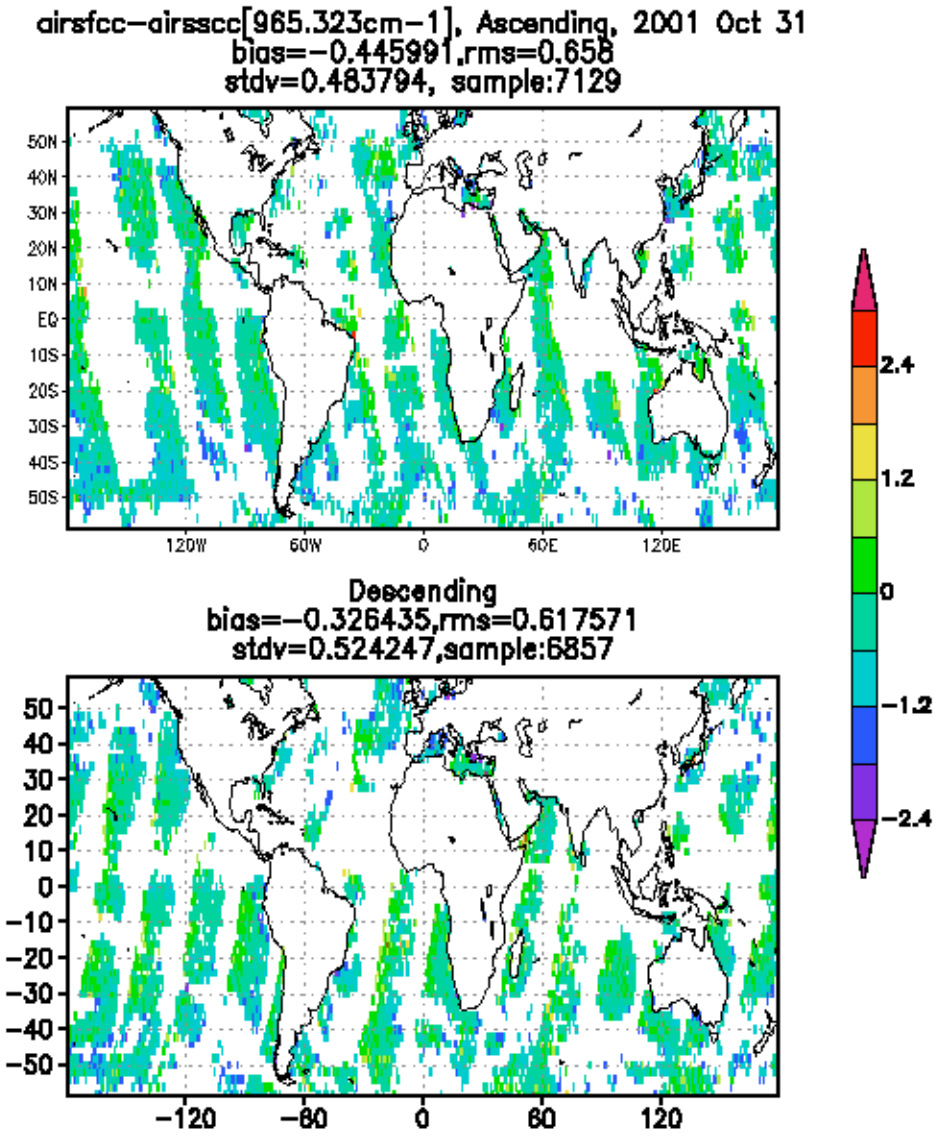
CC (case 3) with 1 K SST



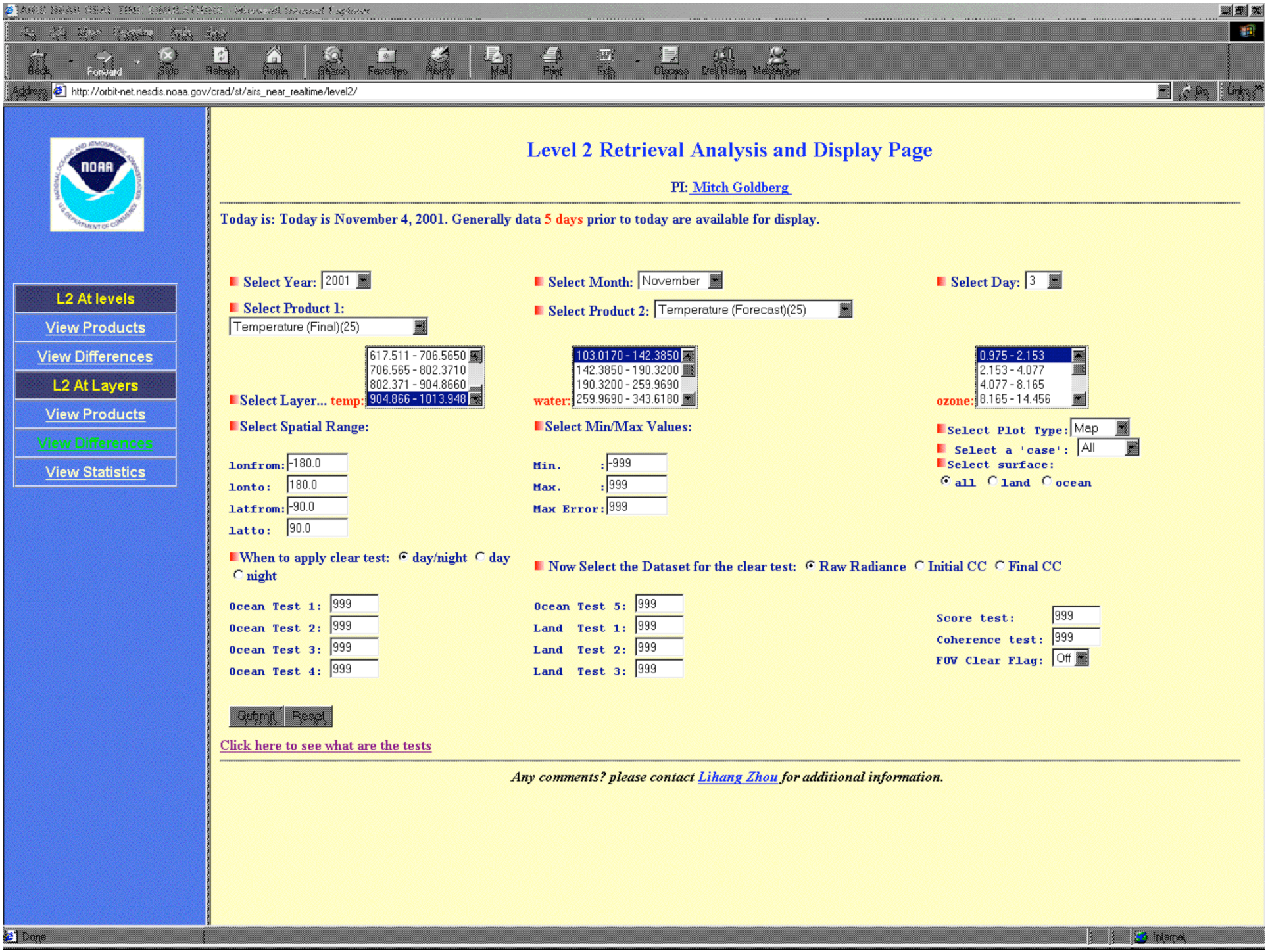
CC (all) 1 K SST check

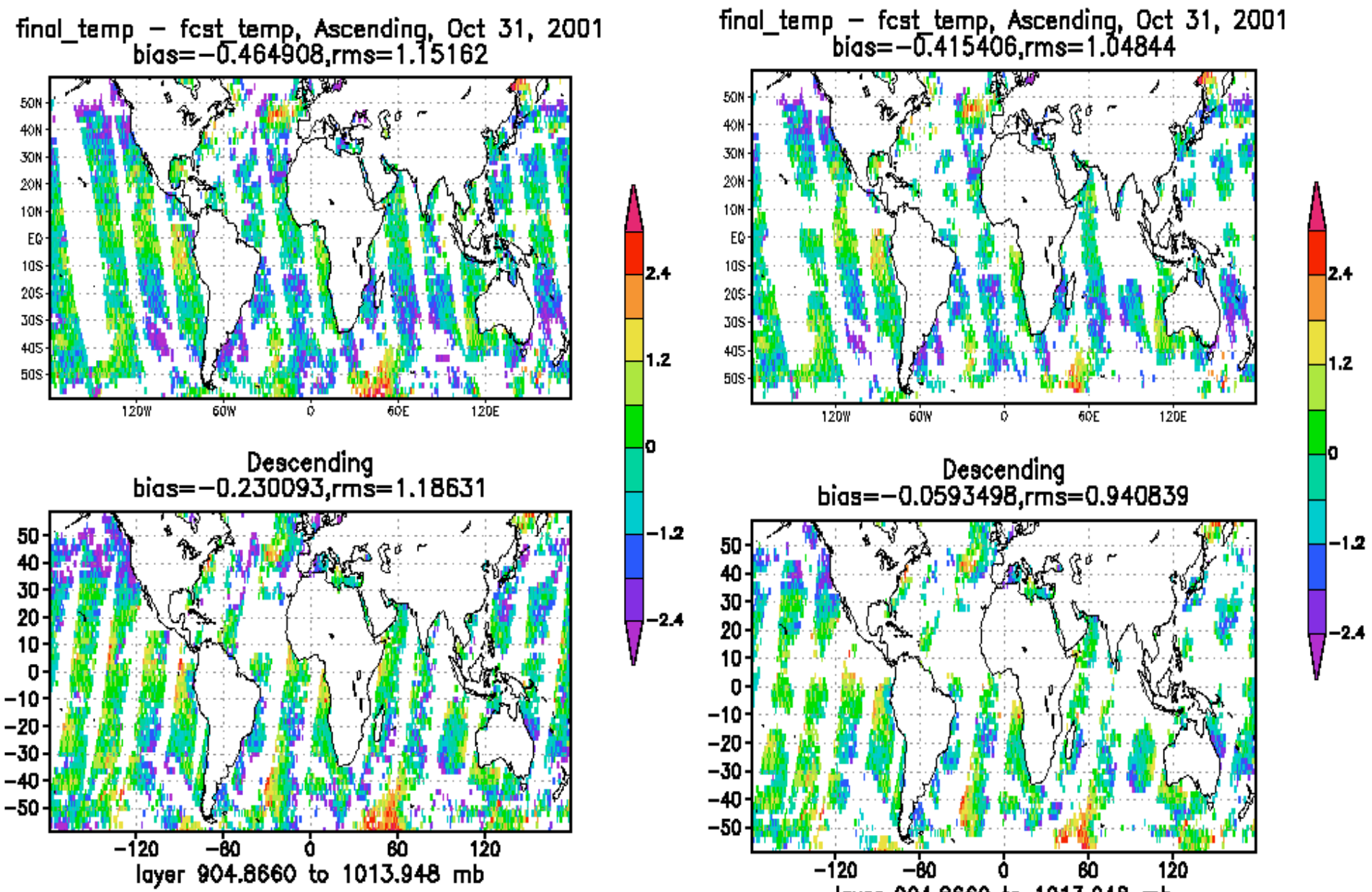


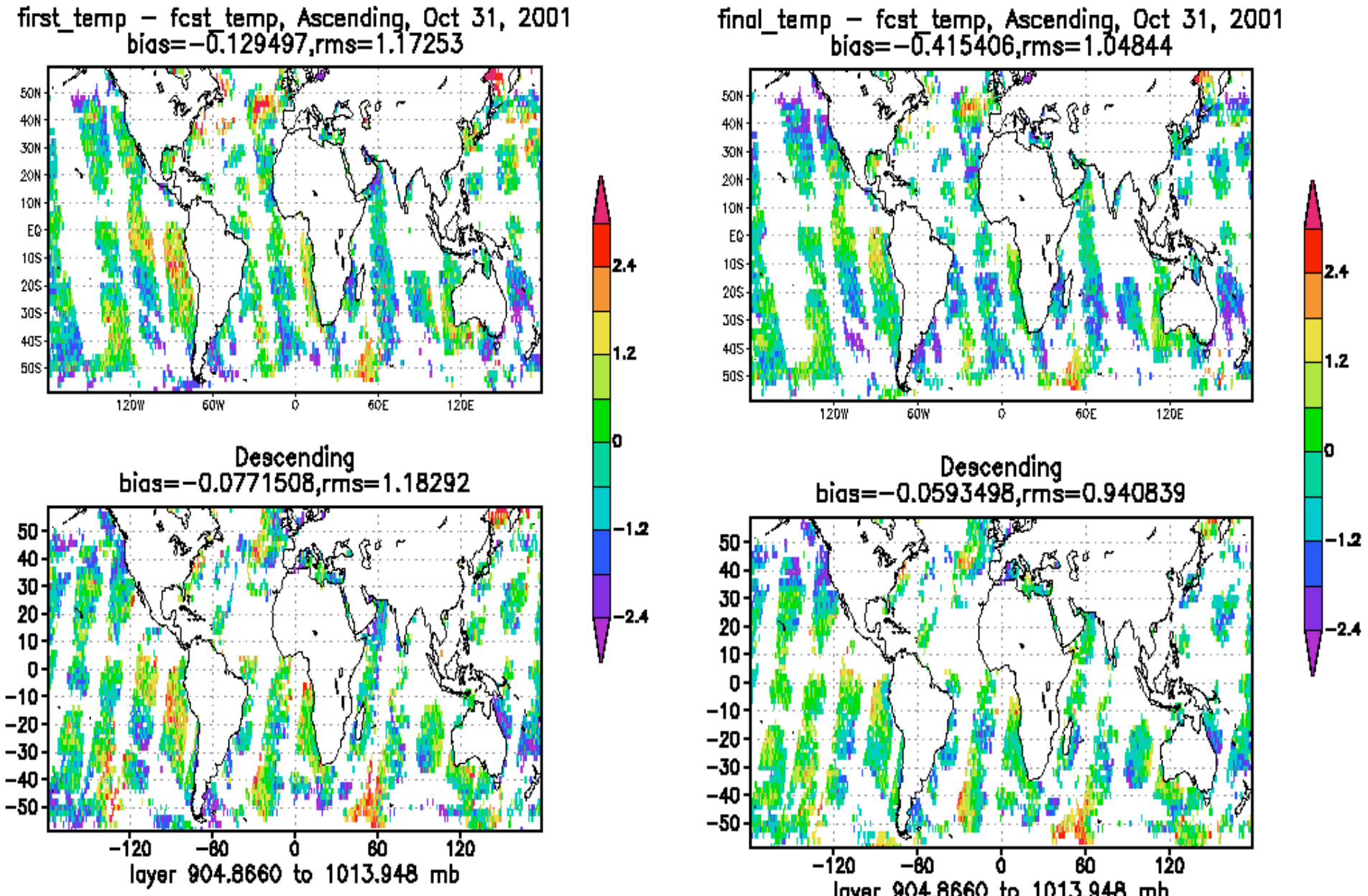
CC (case 3) with 1 K SST



Retrieval Validation


Address http://orbit-net.nesdis.noaa.gov/crad/st/airs_near_realtime/level2/
L2 At levels
View Products
View Differences
L2 At Layers
View Products
View Differences
View Statistics
Level 2 Retrieval Analysis and Display Page
PI: Mitch Goldberg
Today is: Today is November 4, 2001. Generally data 5 days prior to today are available for display.
Select Year: 2001
Select Month: November
Select Day: 3
Select Product 1:
Temperature (Final)(25)
Select Product 2: Temperature (Forecast)(25)
Select Layer... temp: 617.511 - 706.5650 706.565 - 802.3710 802.371 - 904.8660 904.866 - 1013.948
water: 103.0170 - 142.3850 142.3850 - 190.3200 190.3200 - 259.9690 259.9690 - 343.6180
ozone: 0.975 - 2.153 2.153 - 4.077 4.077 - 8.165 8.165 - 14.456
Select Spatial Range:
lonfrom: -180.0
lonto: 180.0
latfrom: -90.0
latto: 90.0
Select Min/Max Values:
Min. : -999
Max. : 999
Max Error: 999
Select Plot Type: Map
Select a 'case': All
Select surface:
all land ocean
When to apply clear test: day/night day night
Now Select the Dataset for the clear test: Raw Radiance Initial CC Final CC
Ocean Test 1: 999
Ocean Test 2: 999
Ocean Test 3: 999
Ocean Test 4: 999
Ocean Test 5: 999
Land Test 1: 999
Land Test 2: 999
Land Test 3: 999
Score test: 999
Coherence test: 999
FOV Clear Flag: Off
Submit Reset
Click here to see what are the tests
Any comments? please contact Lihang Zhou for additional information.
Done
Internet


final_temp − fcst_temp, Ascending, Oct 31, 2001
bias=−0.464908,rms=1.15162
50N
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
120W
60W
0
60E
120E
2.4
1.2
0
−1.2
−2.4
Descending
bias=−0.230093,rms=1.18631
50
40
30
20
10
0
−10
−20
−30
−40
−50
−120
−60
0
60
120
layer 904.8660 to 1013.948 mb
final_temp − fcst_temp, Ascending, Oct 31, 2001
bias=−0.415406,rms=1.04844
Descending
bias=−0.0593498,rms=0.940839
layer 904.8660 to 1013.948 mb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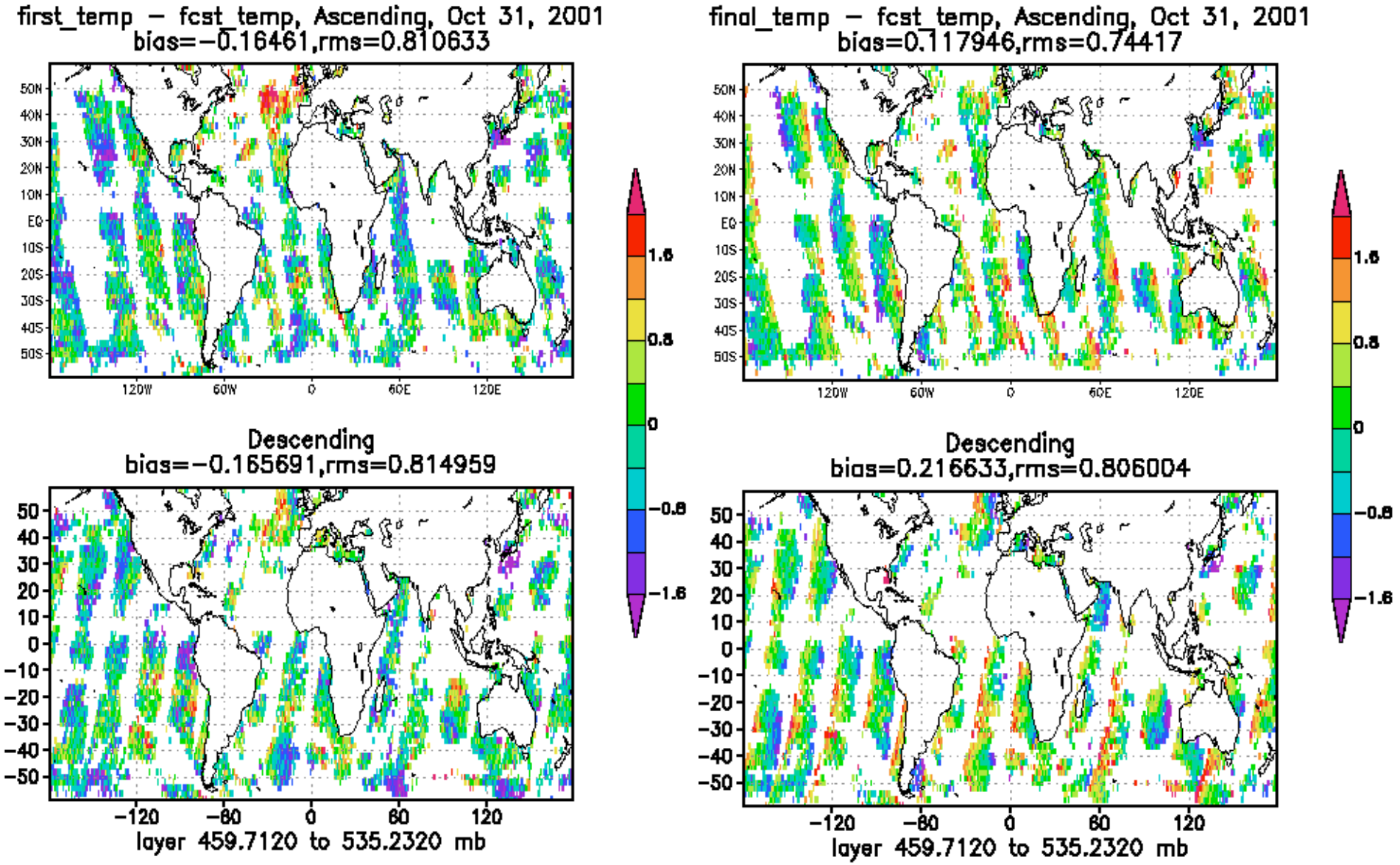
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
120W
60W
0
60E
120E
2.4
1.2
0
−1.2
−2.4
Descending
bias=−0.0771508,rms=1.18292
50
40
30
20
10
0
−10
−20
−30
−40
−50
−120
−60
0
60
120
layer 904.8660 to 1013.948 mb
final_temp – fcst_temp, Ascending, Oct 31, 2001
bias=−0.415406,rms=1.04844
Descending
bias=−0.0593498,rms=0.940839


first_temp − fcst_temp, Ascending, Oct 31, 2001
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40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
120W
60W
0
60E
120E
1.6
0.8
0
−0.8
−1.6
Descending
bias=−0.165691,rms=0.814959
50
40
30
20
10
0
−10
−20
−30
−40
−50
−120
−60
0
60
120
layer 459.7120 to 535.2320 mb
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Descending
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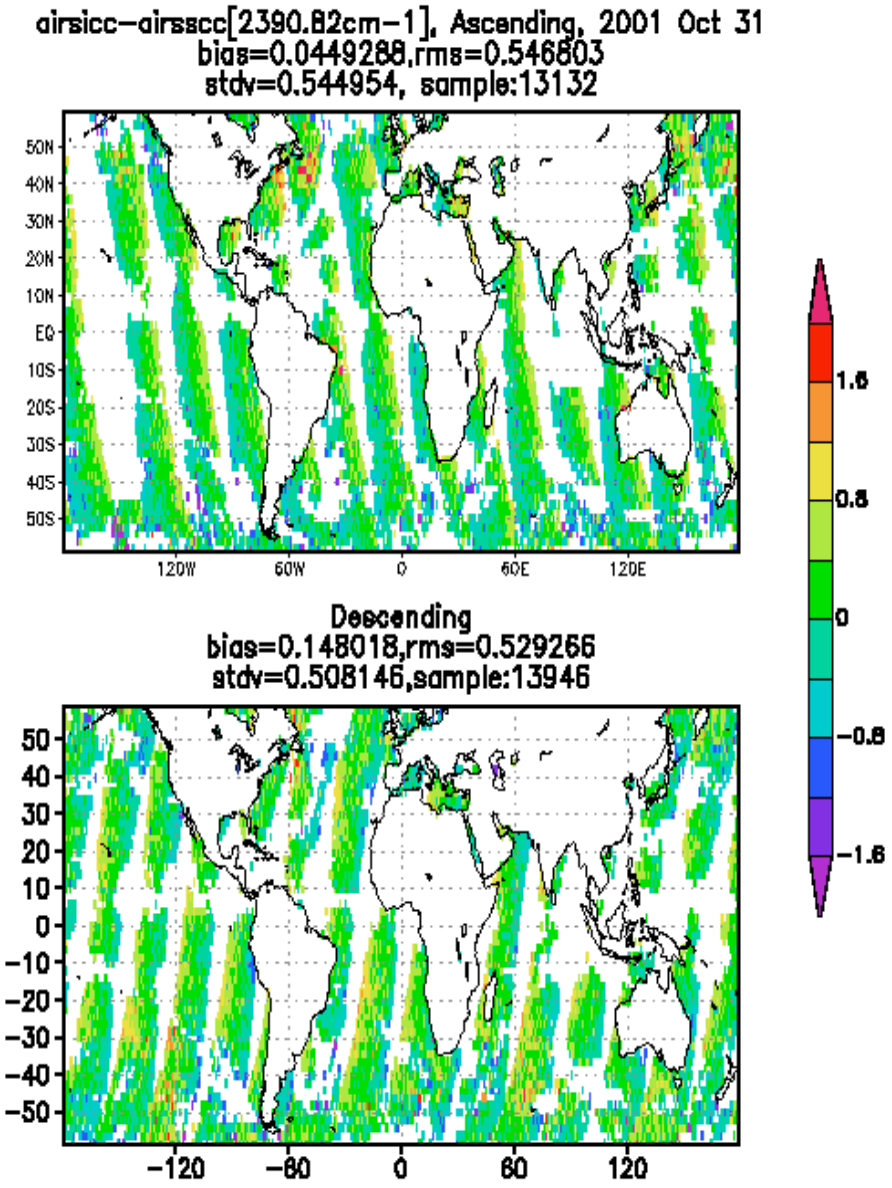
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stdv=0.544954, sample:13132
50N
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
120W
60W
0
60E
120E
1.6
0.8
0
−0.8
−1.6
Descending
bias=0.148018,rms=0.529266
stdv=0.508146,sample:13946
50
40
30
20
10
0
−10
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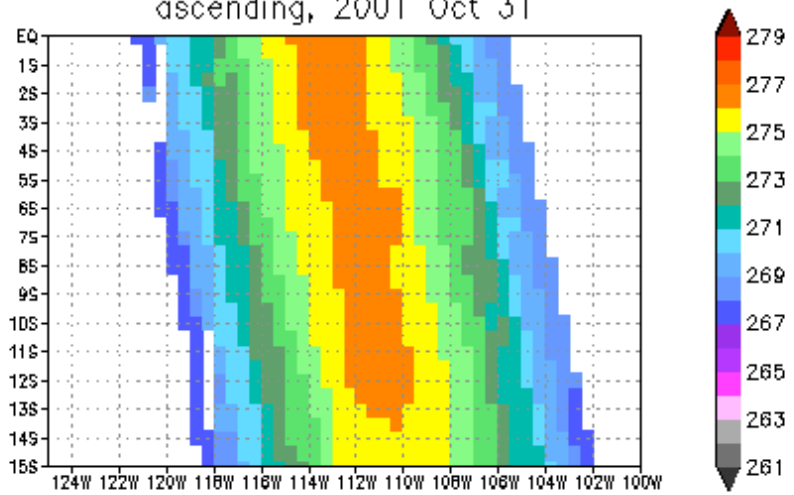
−30
−40
−50
−120
−60
0
60
120


airs [2390.82cm−1]
ascending, 2001 Oct 31
EQ
1S
2S
3S
4S
5S
6S
7S
8S
9S
10S
11S
12S
13S
14S
15S
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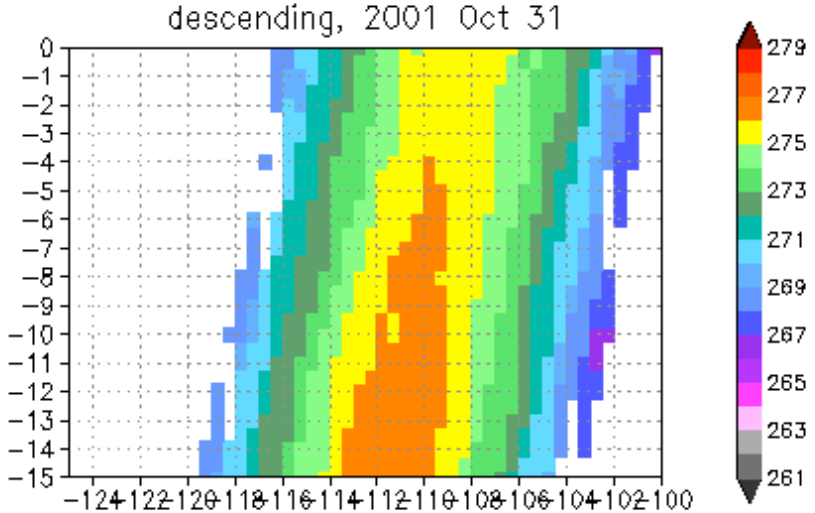
descending, 2001 Oct 31
0
−1
−2
−3
−4
−5
−6
−7
−8
−9
−10
−11
−12
−13
−14
−15
−124 −122 −120 −118 −116 −114 −112 −110 −108 −106 −104 −102 −100
279
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275
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267
265
263
261

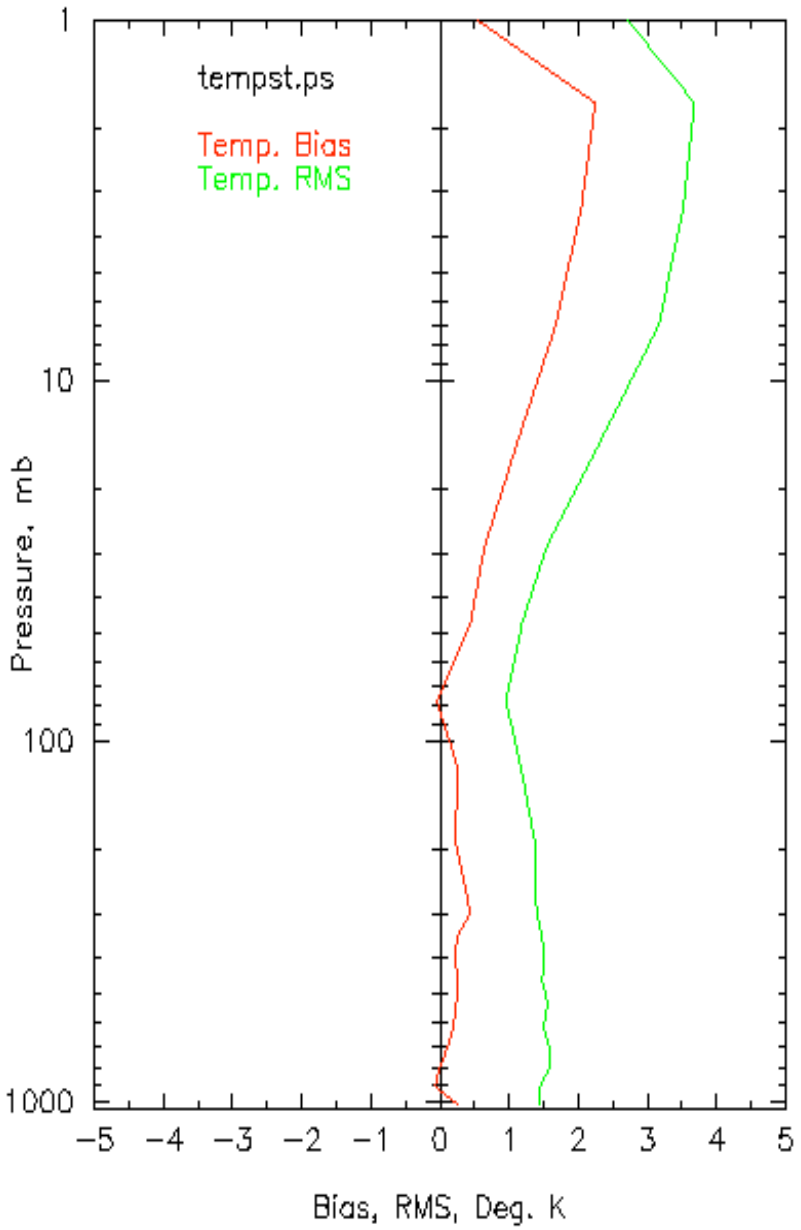
Improvements to validation tools

- Apply to granule level.
- Display vertical channel and retrieval cross sections f(fov #, time, longitude)
- Display spectra bias and rms for given region
- Develop offline web browser capability (ftp gridded files and display on local machine)
- Monitor time series of bias and standard deviation (radiances and retrievals).

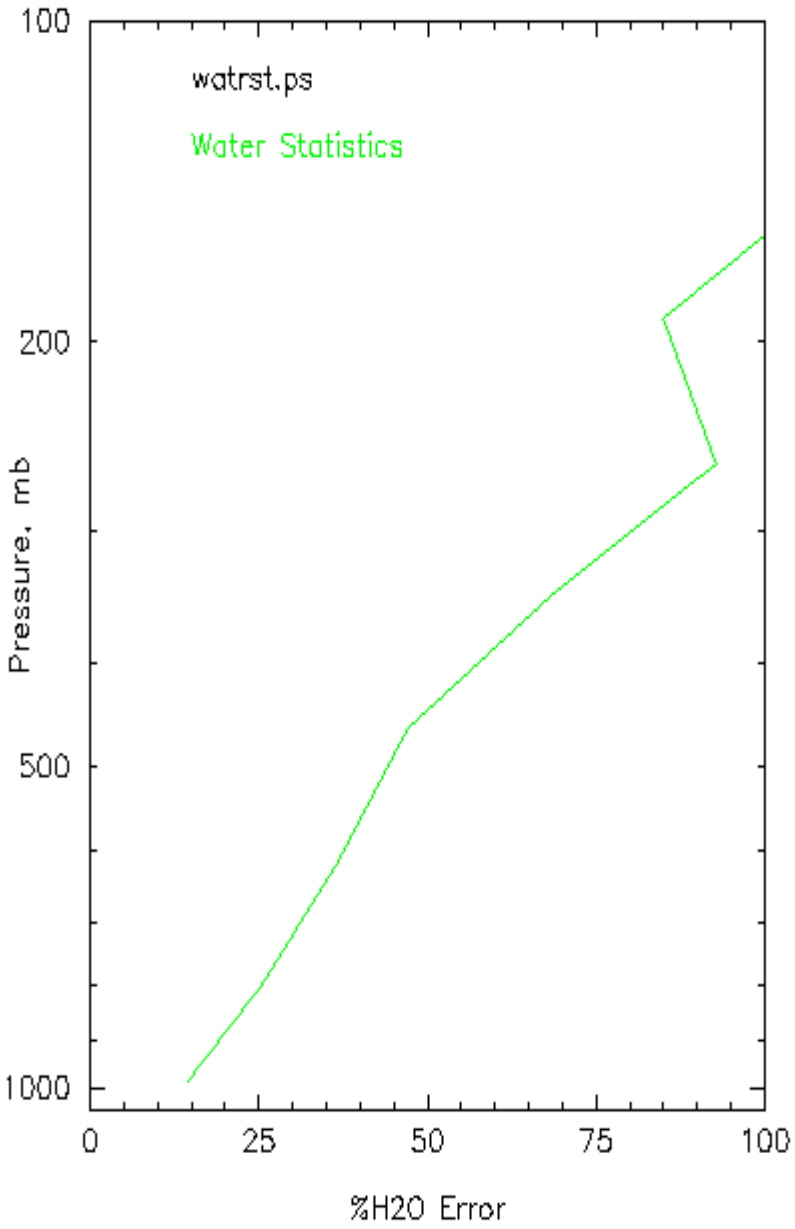
Validation using NOAA-16 operational radiosonde match files

- NOAA-16 has a similar equator crossing time to AQUA.
- Matching AIRS Golfballs to NOAA-16 matchups ~ 300 per day - since June 01.
- Soon matching AIRS retrievals
- NOAA-16 matchup files includes ATOVS retrievals, radiances and radiosonde.
- Add closest forecast and cloud cleared radiances from the grid files.

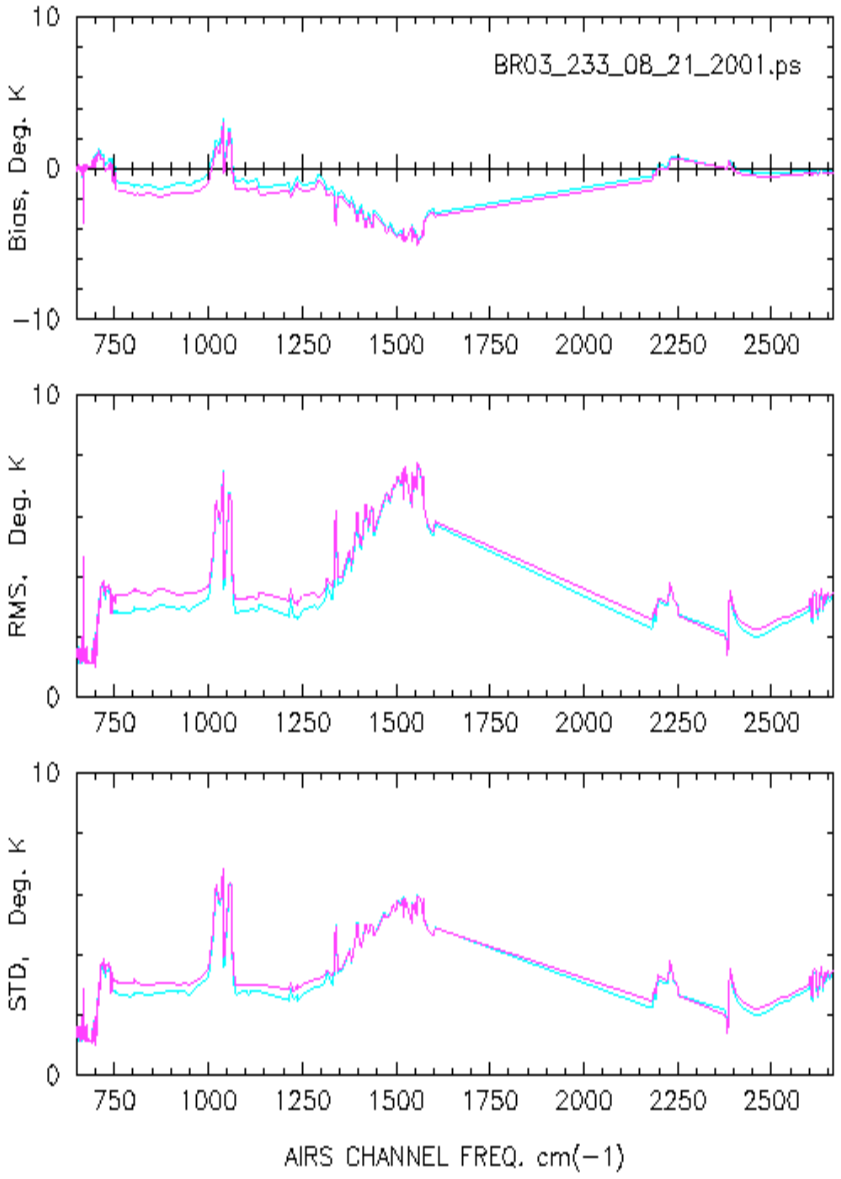
N_16_233_08_21_2001__16_293_10_20_2001 MAXSAMP : 1287



N_16_233_08_21_2001__16_293_10_20_2001 MAXSAMP : 1287

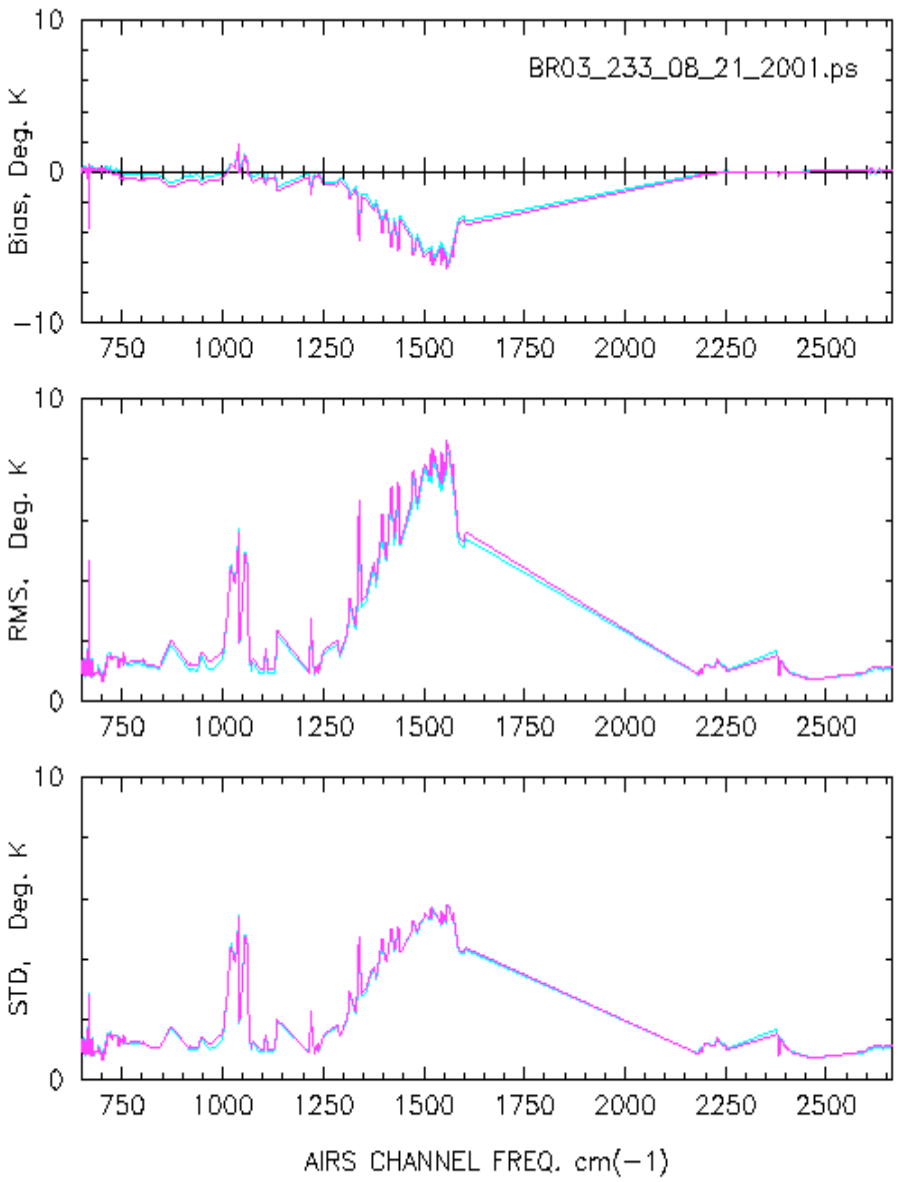


N_16_233_08_21_2001__16_293_10_20_2001 NCH: 281 N: 1287 CASE: 3



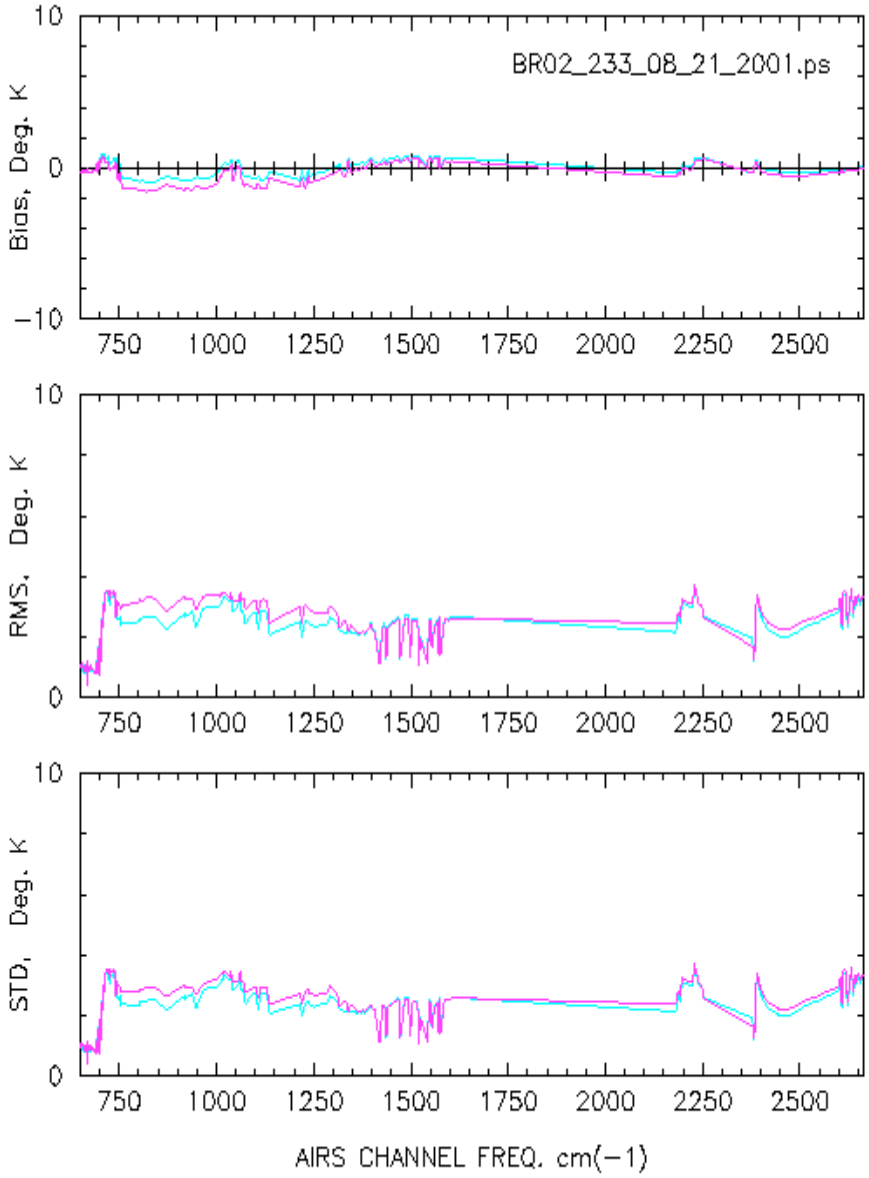
281 CH, OBS(Grid) – Sim(RAOB) INCL NSAMPLES : 1287
281 CH, OBS(Grid) – Sim(RAOB) FICL NSAMPLES : 1287

N_16_233_08_21_2001__16_293_10_20_2001 NCH: 281 N: 767 CASE: 3



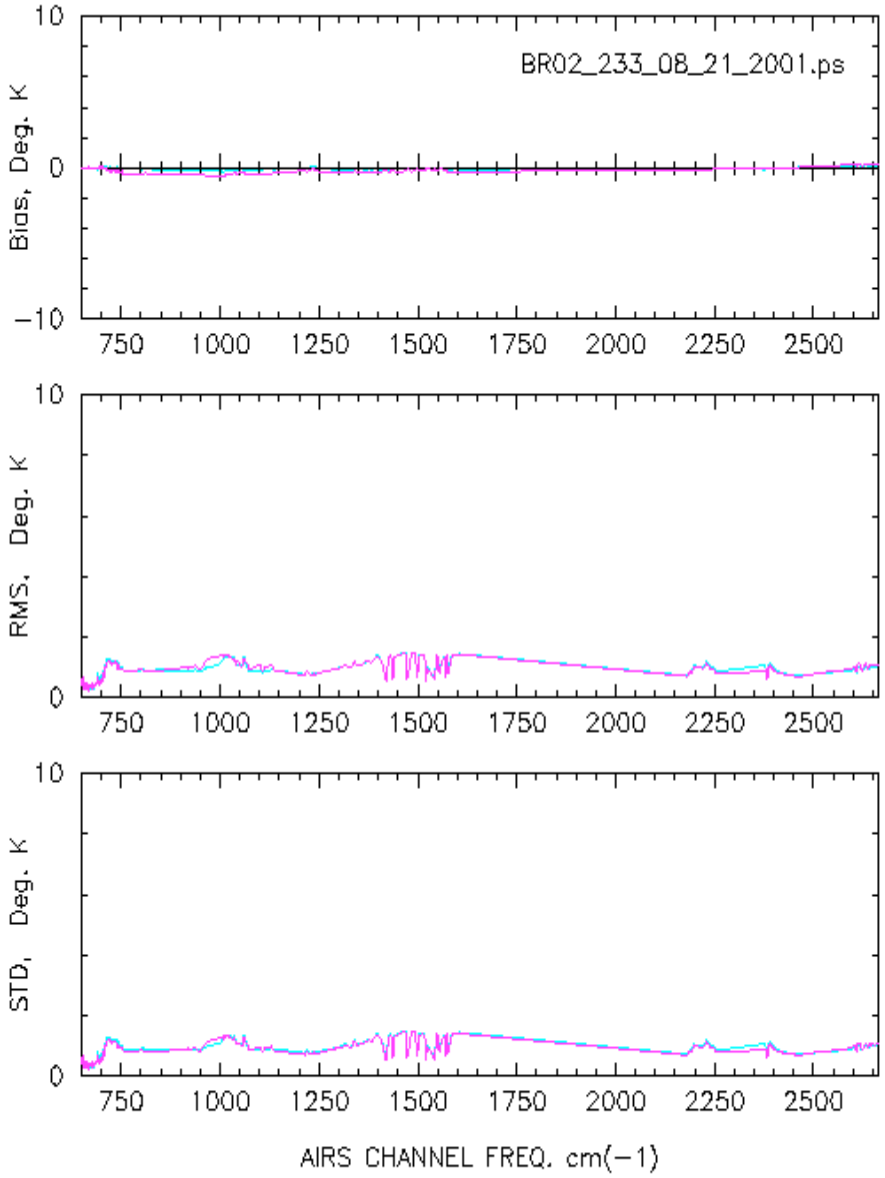
281 CH, OBS(Grid) – Sim(RAOB) INCL NSAMPLES : 767
281 CH, OBS(Grid) – Sim(RAOB) FICL NSAMPLES : 649

N_16_233_08_21_2001__16_293_10_20_2001 NCH: 281 N: 1287 CASE: 2



281 CH, OBS(Grid) INCL − Sim(MF) NSAMPLES : 1287
281 CH, OBS(Grid) FICL − Sim(MF) NSAMPLES : 1287

N_16_233_08_21_2001__16_293_10_20_2001 NCH: 281 N: 767 CASE: 2



281 CH, OBS(Grid) INCL − Sim(MF) NSAMPLES : 767
281 CH, OBS(Grid) FICL − Sim(MF) NSAMPLES : 649

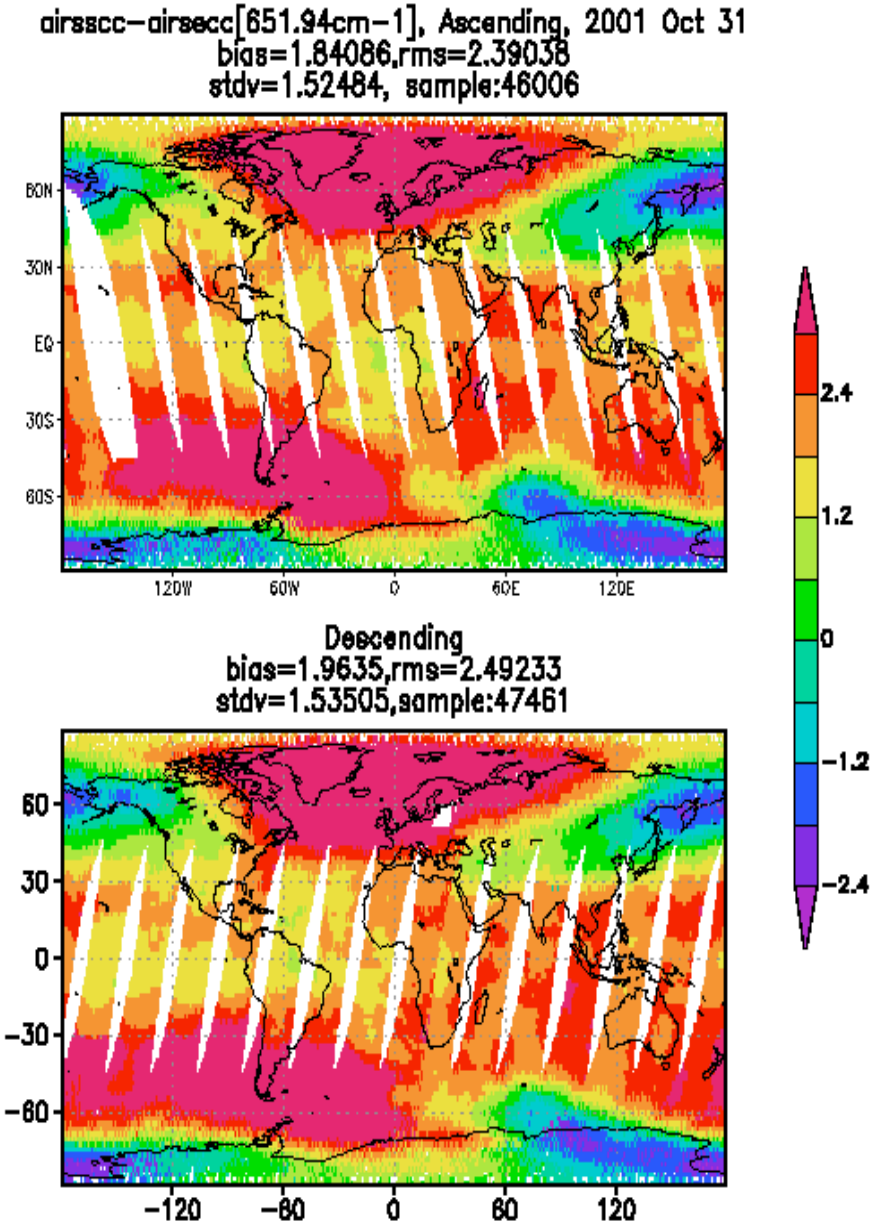
Pre-Summary

- Development of the near realtime system is going extremely well.
- Busy working on NRT validation.
- Working on strategy for updating coefficients (regression and eigenvectors)
- Gridded datasets are the way to go.
- Should be able to provide NWP users with first look radiance products at launch +3 with "blessed" products at launch + 12
- Level 2 products -- launch + 12.

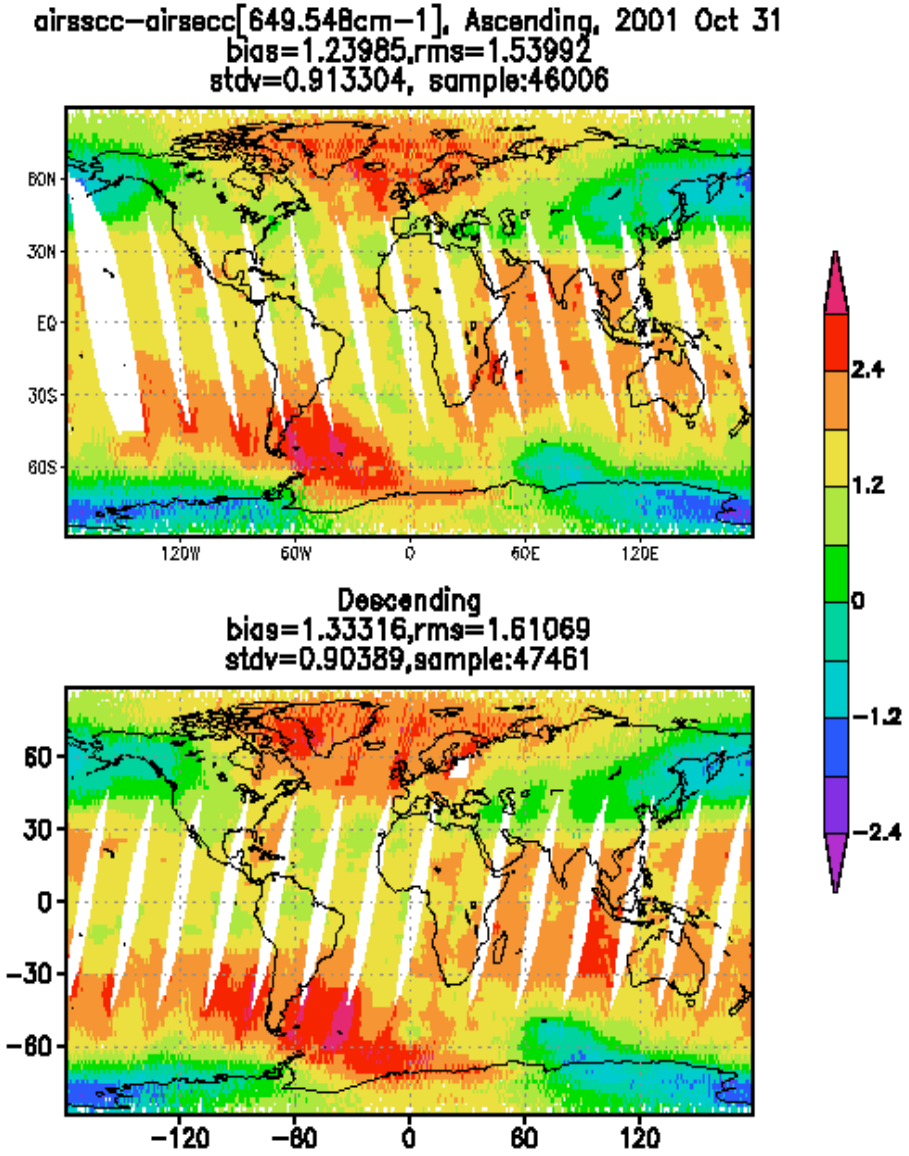
Improvements to regression

- Regression coefficients now based on initial cloud cleared radiances.
- Plan to use ECMWF for training.
- Indications that ECMWF forecast accuracy may be better than NCEP especially for stratospheric temperature and upper tropospheric moisture.

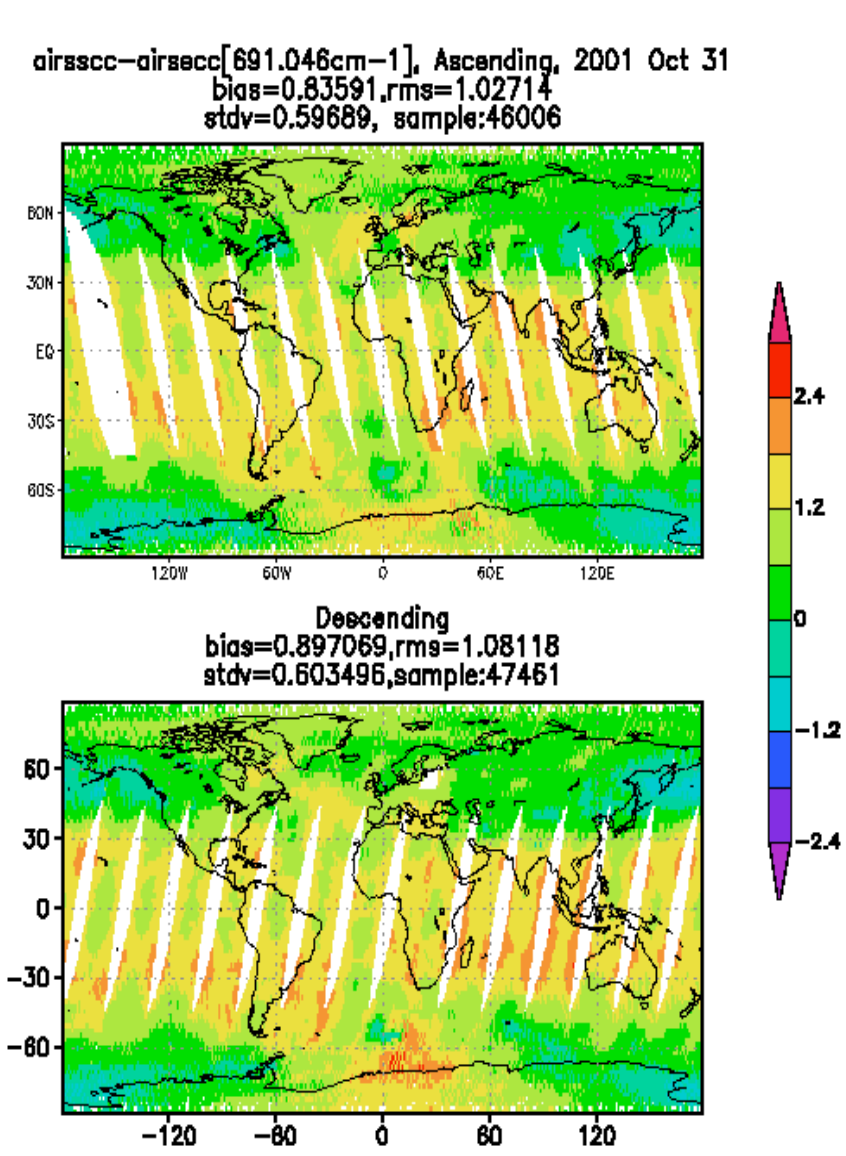
26 mb (6 fwhm)



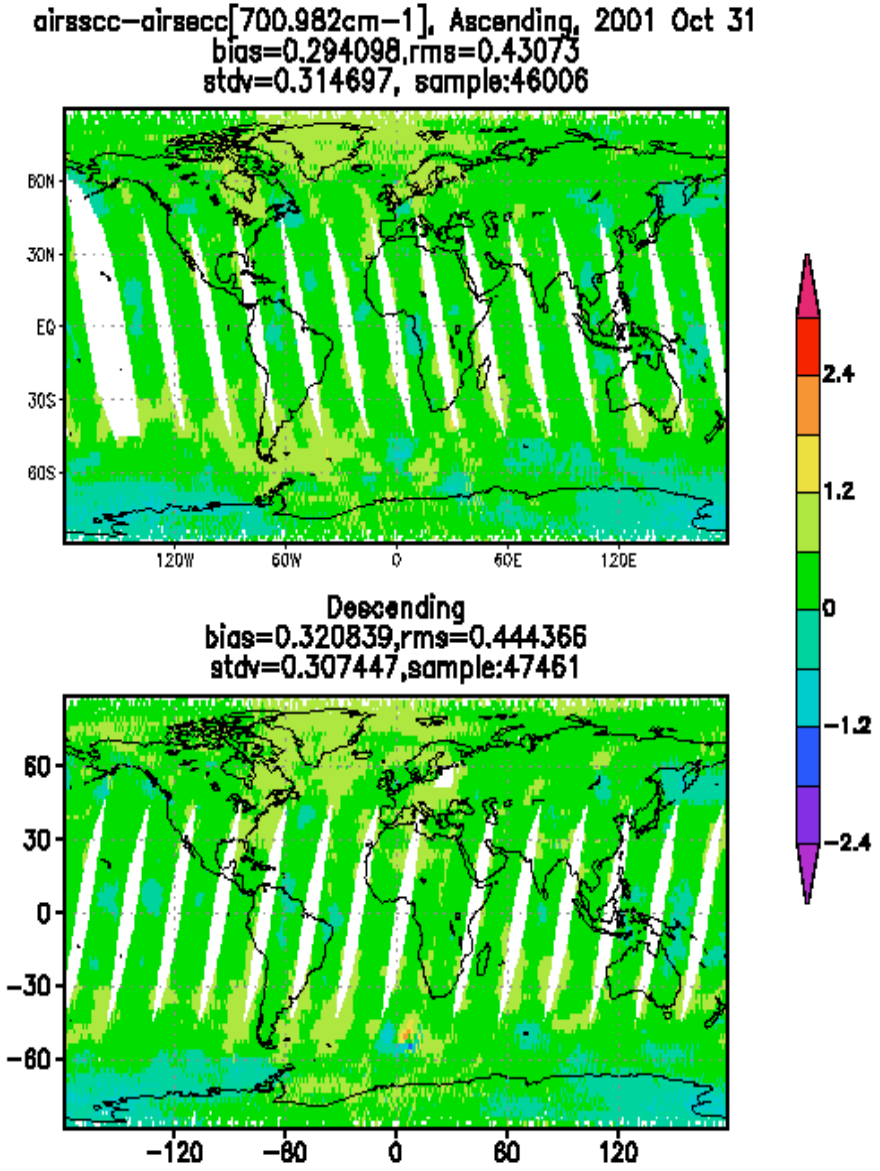
60 mb (16)



180 mb (72)

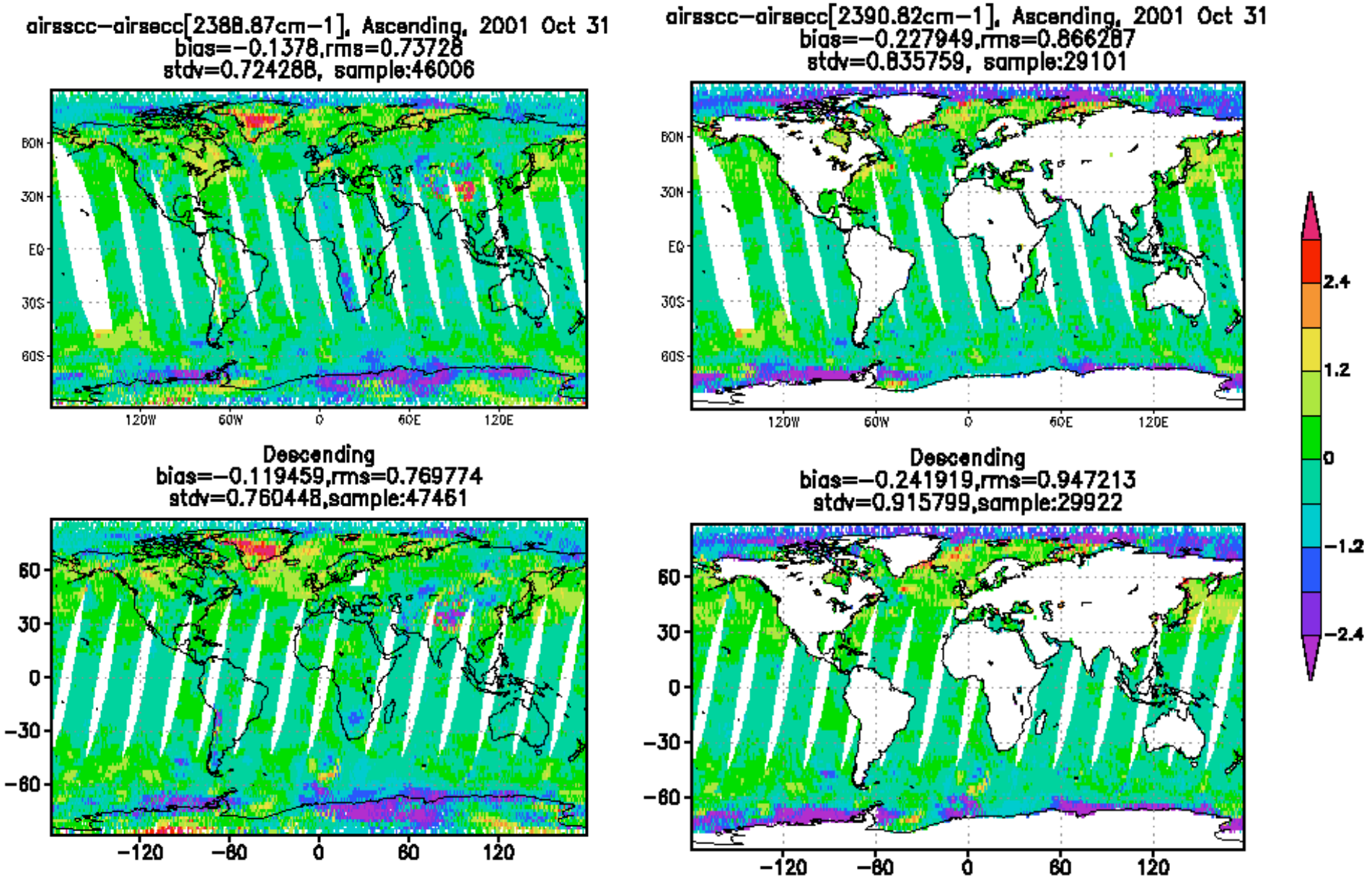


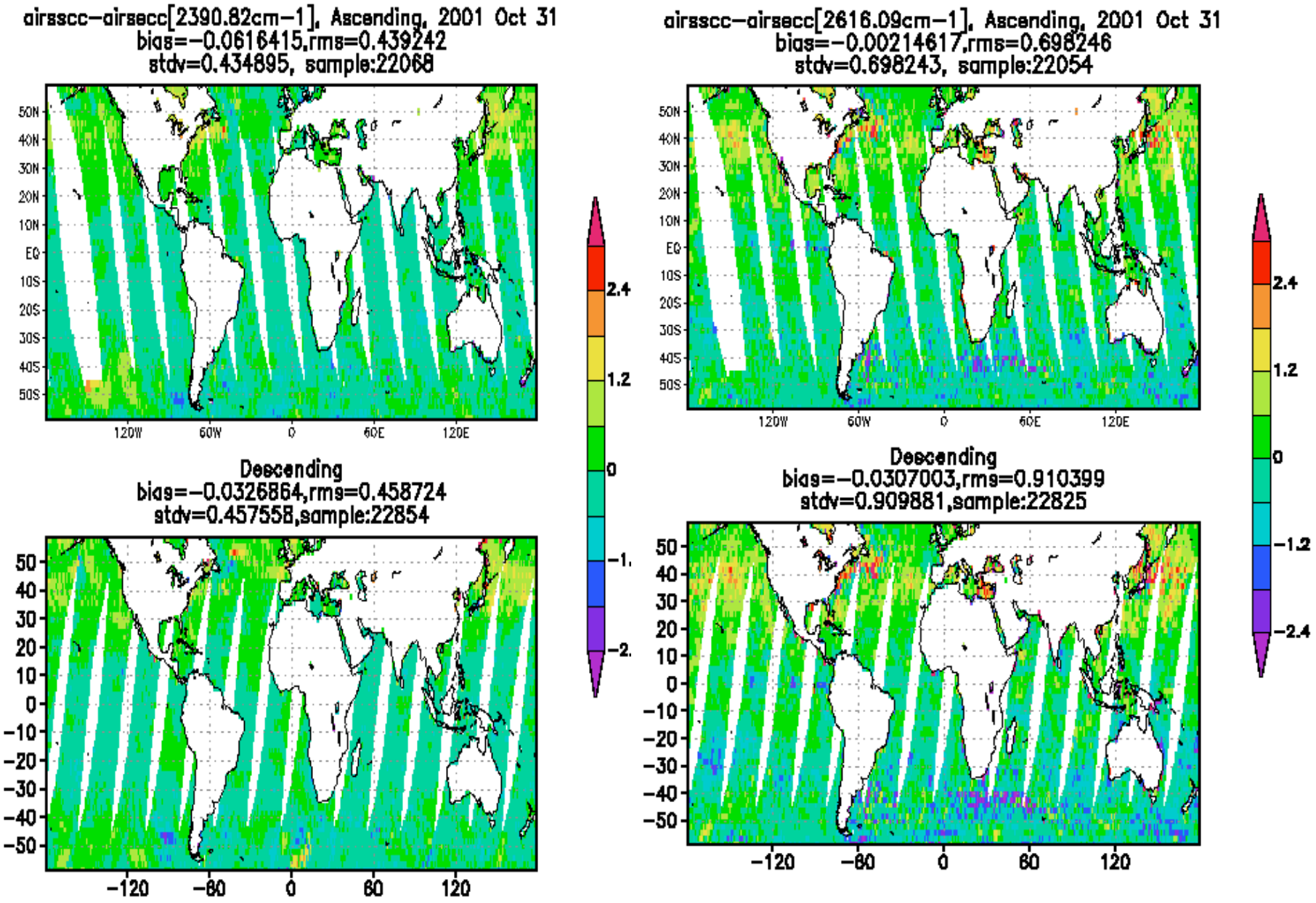
300 mb (180)



555 mb (358)

878 mb (541)

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40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
120W
60W
0
60E
120E
Descending
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40
30
20
10
0
−10
−20
−30
−40
−50
−120
−60
0
60
120
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0
−1.
−2.
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stdv=0.698243, sample:22054
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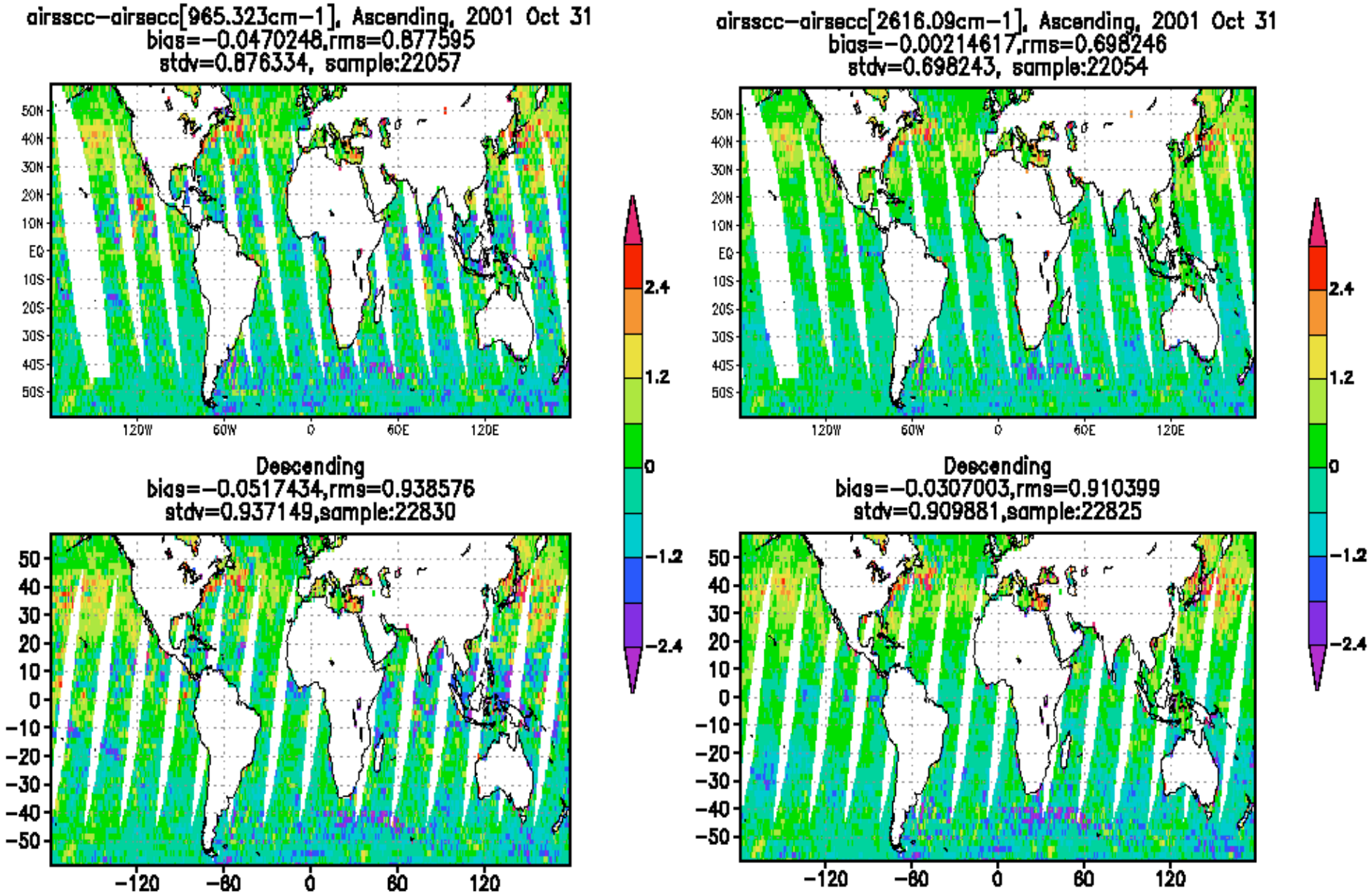
−2.4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20N
10N
EQ
10S
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30S
40S
50S
120W
60W
0
60E
120E
Descending
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0
−1.2
−2.4
airsscc−airsecc[2616.09cm−1], Ascending, 2001 Oct 31
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Descending
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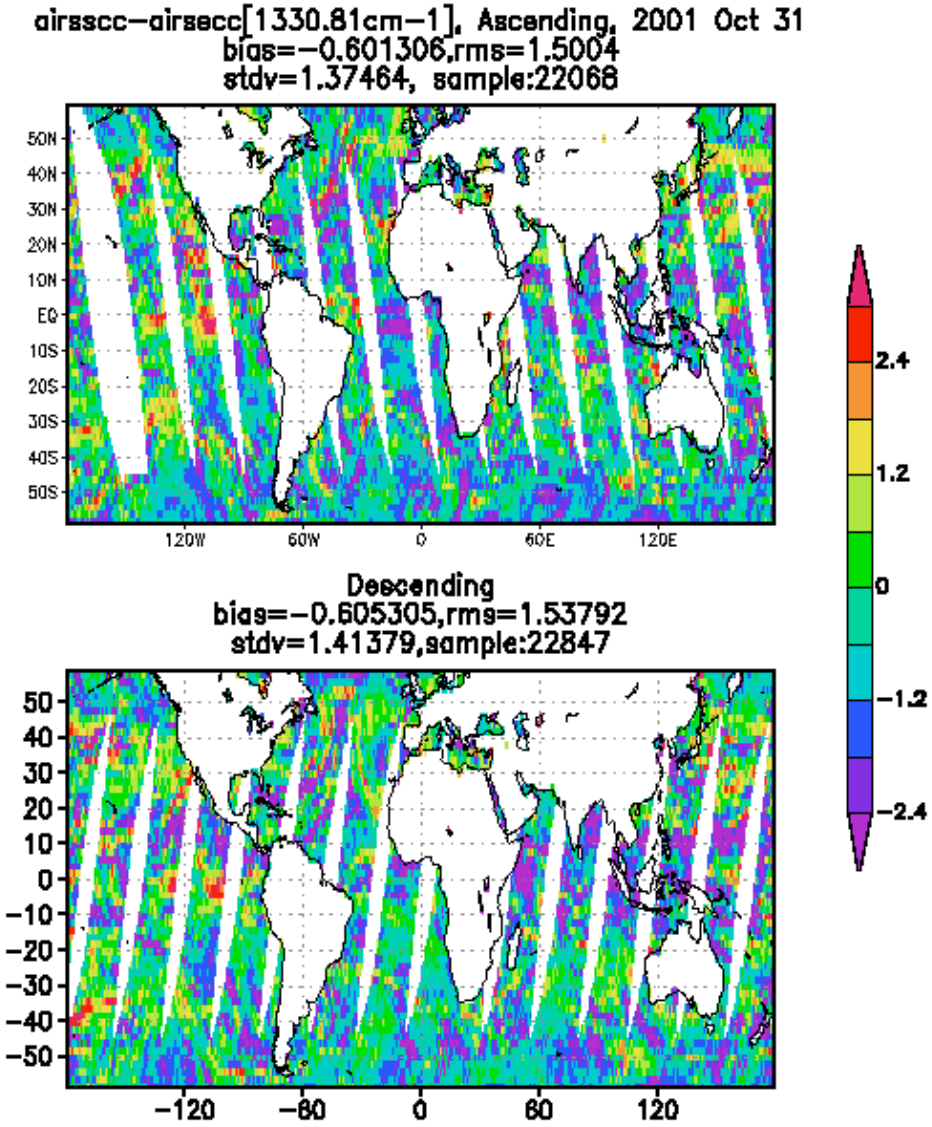
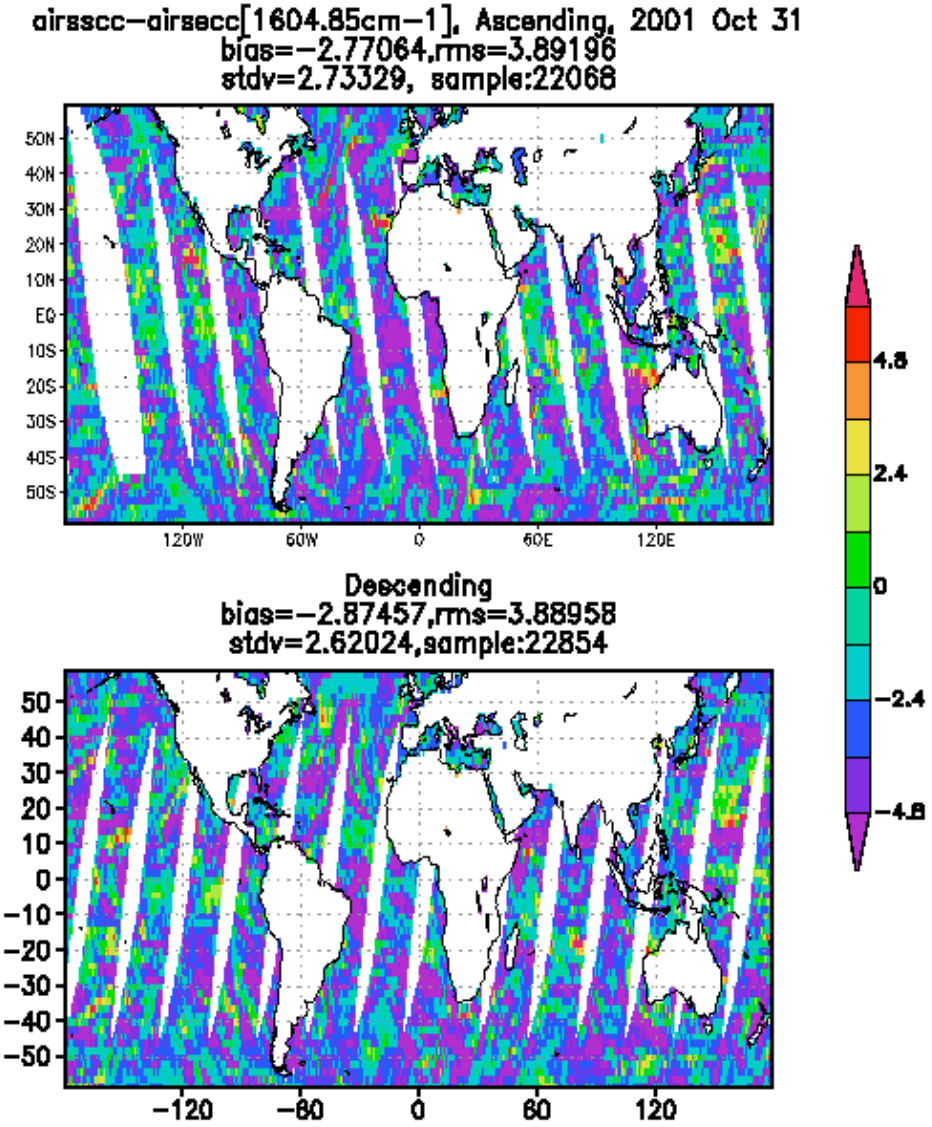
640 mb (480)



375 mb (268)



Final - Summary

- Strong case for using ECMWF forecast for training.
- Larrabee will show more examples.